



PLACIDO BAYOU

PHASE I AND II LAKE BANK RESTORATION & STABILIZATION REPORT

Prepared for:
PLACIDO BAYOU LAKE COMMITTEE

CHARLOTTE ENGINEERING & SURVEYING, INC.

Date: November 2008



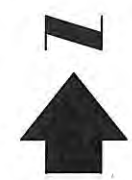
**Placido Bayou
Lake Bank Restoration and Stabilization Report
Phase I and Phase II**

The Placido Bayou Community Association (PBCA) through its Lake Committee contracted with Charlotte Engineering to evaluate possible methods, other than constructing seawalls, to restore and stabilize the shorelines of all the lakes within the community. A two phase study was conducted for this purpose. The first phase was a pilot study that evaluated all of the lakes and presented various alternatives for bank restoration and stabilization. In addition, the pilot study focused in detail on Lake Messina and Lake Lucerne and presented findings and recommendations for stabilization and restoration of these lakes. The pilot study report was completed in August 2008 and submitted to the PBCA. Subsequently, the PBCA authorized Phase II of the project.

The Phase II study was a continuation of the evaluation that was begun in Phase I for the remainder of the lakes within Placido Bayou. The Phase II study provided specific recommendations for lake bank stabilization and restoration throughout the development. In preparing the recommendations, several factors were considered. These included cost, reliability, safety, constructability, access and aesthetics. The Phase II study was completed in October 2008 and revisions were incorporated in November 2008.

Presented in this document are both the Phase I and Phase II reports combined. Since the Phase II study builds on information presented in the Phase I study, combining the reports into a single document provides a complete reference for this work.

A key map showing all of the lakes within the Placido Bayou community is provided on the following page for reference.



NOT TO SCALE

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EB No. 2904
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KEY MAP

LAKE BANK RESTORATION & STABILIZATION

PLACIDO BAYOU
 PINELLAS COUNTY, FLORIDA

DATE:	OCTOBER-08
SCALE:	AS NOTED
DRN. BY:	I.C.G.
CHK'D. BY:	D.M.V.
PROJ. #	12478

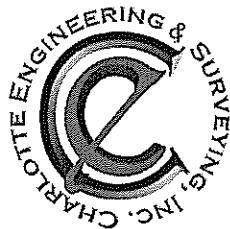
SHT-KM

PLACIDO BAYOU

Lake Bank Restoration and Stabilization Pilot Study Report

PREPARED FOR:

PLACIDO BAYOU LAKE COMMITTEE
ST. PETERSBURG, FLORIDA



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AUGUST 2008

PLACIDO BAYOU LAKE BANK RESTORATION AND STABILIZATION
PILOT STUDY REPORT

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APPENDIX

Placido Bayou Lake Bank Restoration and Stabilization
Pilot Study Report

I. Background and Purpose of Pilot Study

The construction of Placido Bayou involved the excavation of several lakes. These lakes were excavated for borrow material to fill the land to a suitable elevation for development. The lakes were integrated into the layout of the development to provide amenity features. Upon completion of the excavation, the edges of the lakes were left in an unprotected condition with landscaped St. Augustine grass extending to the lake edge; no littoral planting zone for shoreline erosion protection was provided.

Over the years, the natural process of continued bank erosion has occurred. In many locations, the edges of the lakes have expanded by 10 feet or more beyond the original bank edge. Photo 1 shows a typical condition of the eroded lake edge. Note that the grass extends to the water's edge and is being continually undermined by the wave action on the lake. This results in a slow but continued collapse of the lake edge as well as its outward migration. Photo 2 shows a culvert headwall that originally was located at the edge of the lake. Note that the headwall is now 10 feet beyond the existing waters edge. In several of the lakes, the erosion has been so extensive that backyards and pool decks were being undermined. In order to prevent further erosion, the edges of the lakes in many areas have been protected with seawalls. This provides a hard edge to the lakes with no opportunity for vegetation to grow at the waters edge. See Photo 3.

As the erosion is ongoing in the lakes, the Placido Bayou Community Association has taken action to evaluate possible methods, other than constructing seawalls, to stabilize the banks. Charlotte Engineering was contracted to study the lakes and provide alternatives for bank stabilization. This pilot study has been completed to present these findings and evaluations.

II. Proposed Work Scope and Product

In order to determine the extent of the erosion and to evaluate possible alternatives to bank stabilization, Charlotte Engineering conducted an initial reconnaissance of all of the lakes to observe/document the existing conditions and evaluate solutions that have already been implemented along the lake edge to prevent erosion. The work approach and work plan was discussed with the lake committee. In addition, Lake Doctors, who was contracted to provide plantings in the lake as part of a planting pilot study, was contacted to coordinate work scope.

As part of the data collection, an existing conditions survey of the banks of Lake Lucerne and Lake Messina was performed. Numerous cross sections were surveyed to establish the existing bank profile. This survey data shows that the bank at the lake edge is near vertical and is continuing to fail. Photos were taken to document these conditions. Cross sections of the existing bank edge and typical photographs are provided in the appendix of the report.

Using the data collected in the field, manufacturers of various geotextile products used in lake bank restoration were contacted, and alternatives for restoring the lake banks were prepared considering the available bank restoration products currently available. Past projects that have been completed were used as examples to demonstrate possible solutions. Following the documentation of existing conditions and the preparation of recommendations of possible solutions, ranges of costs for the restoration work were developed in order to evaluate the cost effectiveness of each of the solutions. Possible solutions are presented in the following section.

III. Bank Restoration Solutions

Considering the existing conditions of the lake banks, access to the lake edge, construction methods, and extent of disturbance required for each alternative, six possible alternatives were deemed appropriate for the bank restoration work. Although numerous bank restoration methods exist, many were considered too “industrial” in appearance (e.g. riprap, Hydrotech concrete mat), or too complex for the required application (e.g. cable-linked concrete blocks). See Photo 4. The six alternatives that are recommended for further consideration would be (1) geotextile tube erosion control, (2) gabion mattresses with vegetation, (3) Geoweb cellular confinement systems, (4) Coir Fiber Matrix System, (5) Coir Rolls (Turtle Logs) System, and (6) Live planting and Pre-vegetated mats. Each of these is described below.

Geotextile Tube Erosion Control

The geotextile tube erosion control product consists of a linear tube made from a geotextile fabric that is filled with dredged material from the lake. The installation method for this product involves removing the existing vegetation several feet landward from the lake’s edge. After the installation area is cleared of vegetation, the first layer of geotextile tube is placed against the eroded bank face and filled with dredged material pumped from the lake. Once the soil material in the geotextile tube has dewatered by filtering through the geotextile tube fabric, a second layer of geotextile tube is added and filled in a similar manner. Following the dewatering of the material in the top geotextile tube layer, the top tube is slit open longitudinally along the lake edge and the geotextile material is folded outward. The material within in the geotextile tube is hand raked over the exposed geotextile to allow the replacement of the sod material. With the geotextile material serving as a base for the vegetation, the bank is protected from erosion.

This method of bank restoration is used to stabilize banks that have eroded in a similar fashion to the lake edges in Placido Bayou. The advantage of this method is that it requires minimal bank disturbance during installation and can be installed in areas with limited access. It is generally installed at the current lake edge without any restoration grading to return the lake edge to its original location. In addition, it is not necessary to lower the lake’s water elevation to install the product. However, more lake edge grading can be performed if desired to reclaim land lost due to erosion. This additional grading adds to the overall cost of construction for this method.

The disadvantage of this method is that it requires continued maintenance on an annual basis to ensure that the integrity of the geotextile tube is not compromised. If the bottom geotextile tube is broken or torn, then there is a great potential for a loss of the erosion protection.

In addition, if the lake level drops during the dry season, and exposes the bottom geotextile tube, then the vertical face of the geotextile tube will be exposed to UV deterioration. Ultimately, the geotextile will fail. In addition, the vertical lake edge during low water conditions has the appearance of a seawall.

This application is very suitable in golf course situations where the lake levels are closely maintained during the dry season through addition of water. See Sheet 4 describing the installation of this product as well as Photos 5 through 7 showing the installation process and final installed condition. The relative ease of installation and minimal disturbance during construction needs to be weighed against the long-term maintenance costs. Expected installed costs for this alternative are in the range of \$50 per linear foot.

Gabion Mattresses with Vegetation

The gabion mattress consists of a metal wire cage that creates containment for large rock material (3 to 4 inch crushed concrete). Unlike the gabion basket which typically has a rectangular box shape, the gabion mattress is relatively flat in configuration. The installation method for this product involves the removing the existing vegetation several feet landward from the lake's edge. In addition, the lake level is lowered to expose enough area below the normal pool to allow placement of the gabion mattress along the lake edge. Once the installation area is cleared of vegetation, a layer of geotextile material is placed along the lake edge. The gabion mattress is placed on top of this material. The mattress is placed such that it extends from below the lake's low water level to above the high water level. After the mattress is placed, the upper section of it can be covered with soil and then sodded.

The advantage of this method is that it requires minimal bank disturbance during installation and can be installed in areas with limited access. It is generally installed at the current lake edge after a limited amount of regrading is performed to return the lake edge to its original slope. However, more lake edge grading can be performed if desired to reclaim land lost due to erosion. This additional grading adds to the overall cost of construction for this method.

The disadvantage of this system is that the gabion mattress will be visible at the waters edge. Even though the slope and contour of the gabion mattress follows the lake bank, the metal wire cage and the large stones remains visible. As a result the lake edge does not have a clean and aesthetic look, but more of an industrial hard edge. This appearance issue can be fixed using a pre-vegetated mat to cover the riprap and provide a material base that will make the riprap more environmentally friendly.

This application is suitable in lakes or stream banks where pedestrian access is very limited, or where the lake is not an amenity feature. See Sheet 7 describing the installation of this product as well as Photo 8 showing the installed condition. As with the geotextile tube product, the relative ease of installation and limited disturbance during construction is an advantage of this product. However, this needs to be weighed against the final aesthetics of the lake edge. The installed costs for this alternative are in the range of \$190 per linear foot.

Geoweb Cellular Confinement System

The geoweb cellular confinement system consists of a geotextile grid that is expanded to create confinement cells. These cells are filled with small rock material, or a mixture of soil and rock. The confinement cells can be covered with sod above the lake's edge. The installation method for this product involves the removal of the existing vegetation and the regrading of the lake edge above and below the normal pool elevation to restore the original bank slope. To perform this grading, the lake level must be lowered and maintained at the lowered level until the lake bank stabilization is complete. Once the grading is completed, a geotextile is placed on the embankment, with the geoweb placed over this material. The geoweb is placed such that it extends from below the lake's low water level to above the high water level. Once the geoweb is placed, cells are filled with either a small angular stone (½ to ¾ inch crushed concrete) or a mixture of rock and soil. Typically, the geoweb below the water's edge is filled with stone, while the section above the water's edge can be filled with a soil and stone mixture and then covered with sod.

The advantage of this system is that the product will be nearly invisible as the sod grows over the geoweb. During normal pool conditions, the geoweb will provide a stable growing media for vegetation (sod or other plant materials) at the lake edge. In addition, the cells below the water level can provide a stable planting area for wetland plants. During the dry season, when lake levels drop, the geoweb can still provide bank protection since it is installed below the expected low water level.

The disadvantage of this system is the extent of the bank disturbance that is required for its initial installation. However, this inconvenience needs to be weighed against the finished aesthetics of the product as well as the minimal long term maintenance of the product. See Sheet 9 describing the installation process, and Photos 9 and 10 showing the installation process and the final installed condition. The installed costs for this alternative are in the range of \$100 per linear foot.

Coir Fiber Matrix System

The coir fiber matrix system consists of a coir blanket made of coir. Coir is processed from the husk of the fruit from the coconut tree (*Cocosmucifera*). This blanket uses synthetic latex as a binder to glue the coir together.

The installation method for this product involves the removal of the existing vegetation and the re-grading of the lake edge above and below the normal pool elevation to restore the original bank slope. To perform this grading, the lake level must be lowered and maintained at the lowered level until the lake bank stabilization is complete. Once the grading is completed, a coir blanket is placed on the embankment. The coir blanket is placed such that it extends from below the lake's low water level to above the high water level. After the blanket is placed, it will be covered with soil and then sodded. The coir blanket will not be visible once the vegetation has regrown.

Advantages of this method are its lower cost and lower long-term maintenance than methods that use geotextiles. The coir fiber matrix system will provide improved bank stability to allow root systems to develop. The blanket also adds to the structural stability of the lake bank.

Environmentally, the coconut blanket is considered superior to plastic-netted blankets. The main reason for the success of the blanket is the initial durability of the coir. However, this durability will diminish over time as the coir fiber decays. The coir erosion control blankets have the capability to cover a broad spectrum of erosion problems. Coir is denser than water so it will not float, it decays very slowly, and allows normal ecological phenomena to occur. The coconut fiber matrix regulates heat and moisture at the soil surface to promote rapid seed germinations while controlling erosion before vegetation becomes established.

The disadvantage of this system is the extent of the bank disturbance that is required for its initial installation. However, this inconvenience needs to be weighed against the finished aesthetics of the product as well as the minimal long term maintenance. After extreme rain events, the coir blanket may have some minor erosion problems where the blanket is embedded into the lake bank. This can be repaired by regrading, then covering it with topsoil and reseeding or sodding. In addition, the long-term durability of this alternative is still unknown. It is expected that due to ultimate decay of the coir material, life expectancy of the fiber is less than 10 years.

See Sheet 11 describing the installation process, and Photos 11 and 12 showing the installation process and the final installed condition. The installed costs of this alternative are in the range of \$25 per linear foot.

Coir Rolls (Turtle Logs) System

This product is made of coir that is densely rolled and compacted into a cylindrical shape and enclosed in a coir twine casing. These cylindrical structures are used to propagate native non-woody herbaceous plants along the waters edge. Typical rolls are 16 inches in diameter and 10 feet in length, and the coir twine casing has 2 in. x 2 in. openings.

The installation method for this alternative involves the removal of the existing vegetation and limited re-grading of the lake edge above and below the normal pool elevation to remove collapsed areas along the bank slope. To perform this grading, the lake level does not need to be lowered. To prepare the lake bank for installation of the rolls, the slope along the water's edge should be reshaped to gradients of 3H: 1V to 4H: 1V. This provides for improved long-term bank stability and easier installation of the rolls. The rolls must be installed along the lake bank where the normal water level of the lake is $\frac{1}{2}$ to $\frac{2}{3}$ of the coir roll's height. Proper submersion of coir rolls is important for successful establishment of vegetation. During installation, the ends of the first and last coir roll are embedded in the lake bank to secure it in place. Plantings or sod is then placed directly on the rolls.

This new bioengineering technique has become a viable option due to the fact that the coir is a good plant growth medium. The border created along the waters edge will provide an opportunity for wetland plantings to root, provide habitat for wildlife and improve water quality through the removal of nutrients. Coir rolls are completely biodegradable. These rolls also are

aesthetically attractive, easy to install, and are less expensive than most alternatives for bank restoration.

Though less bank disturbance is required as compared to the Geoweb cellular confinement system or the coir fiber matrix system, some bank disturbance is required for its initial installation. However, this inconvenience needs to be weighed against the finished aesthetics of the product as well as the minimal long term maintenance of the product. After numerous rain events the coir rolls may have some minor erosion problems where the rolls are embedded into the lake bank. This can be repaired by placing riprap at the junctions, then covering it with topsoil and reseeding. In addition, the long-term durability of this alternative is still unknown. It is expected that due to ultimate decay of the coir material, life expectancy of the fiber is less than 10 years.

See Sheet 13 describing the installation process, and Photos 13 and 14 showing the installation process and the final installed condition. The installed costs of this alternative are in the range of \$10 per linear foot.

Live Planting and Pre-vegetated Plant Mats

This system involves the use of live plants to add structural strength to soil. Many different plant materials are used, and live cuttings should be soaked in cold water for at least 24 hours before they are used. This not only provides the cuttings with needed moisture but also improves rooting. Live potted plants often are used.

Care of live plants before and during planting is critical for success. Plants can be planted directly into coir roll logs or coir blankets or pre vegetated mats. A pre-vegetated mat is one method used to transplant live plants. A plant roll can be developed by wrapping several live plants in a roll of degradable material and placing the roll on the ground. Proper vegetation types are essential for a successful design. Herbaceous and woody plants are needed. Herbaceous plants, or wetlands plants, will be needed at and near the water's edge. The plants can grow with their roots underwater. This root growth adds considerable strength to the soil. Generally, using several different wetland plant species adds considerable strength to the soil. Woody plants should be used on the upper slope and upland areas where their roots can grow in soil above the water table.

One of disadvantages is the availability of plant species in the appropriate size and quantity. This can be a limiting factor in the final selection process. Local nurseries may not carry the type of wetland plants needed. They may be able to propagate the species needed, but this will take 12 to 18 months. In addition, it is necessary to protect live plantings from animals, especially duck and geese along lakeshores. Muskrats, dogs and humans also can pose a threat. Signs may keep people way, but sometimes fencing is needed. Also, protection from flooding or excess water flowing across the planting is important to establish the plants.

See Sheet 15 showing a typical installation cross section. The installed costs of this alternative are in the range of \$1 to \$5 per linear foot based on the density of the plantings.

IV. General Recommendations and Conclusions

There are several factors to consider in the selection of an appropriate solution, including cost, reliability, longevity, safety, constructability and aesthetics. Our studies as well as other's studies of lakes have been used to determine the advantages and disadvantages on long term performance of the alternatives for bank stabilization.

The design of rehabilitation measures and restoration of the shoreline usually requires the application of a combination of the above-described alternatives. The success of the restoration hinges on many factors including proper design, proper installation, plant selection, weather conditions, outside factors like animal damage and water elevation (the most critical element in a successful installation).

Until recently, restoration designs typically used rock riprap or retaining wall structures to correct shoreline erosion. Even though these methods may correct the targeted problems, they are expensive, do not allow normal ecological phenomena to occur, and/or provide poor aesthetic appearances. For this reason, we would recommend the use of the following methods for lake bank restoration and stabilization:

- Geotextile Tube Erosion Control,
- Geoweb Cellular Confinement System,
- Coir Fiber Matrix System,
- Coir Rolls (Turtle Logs) System, and
- Live Planting and Pre-vegetated Plant Mats

Primarily due to aesthetics, we would not recommend the use of Gabion Mattresses with Vegetation. In addition, this is a very costly alternative with an installed cost in the range of \$190 per linear foot. In certain special cases, this alternative may be appropriate.

Depending of the specific location within Placido Bayou, any one or any combination of the above alternatives can be implemented. In areas where it may not be practical to lower the lake level or regrade the lake edge, geotextile tube erosion control may be the most desirable alternative. In areas where access is very limited due to proximity of homes, geotextile tube erosion control, coir rolls (Turtle Logs), or live planting and pre-vegetated plant mats may be the selected alternatives. In areas where erosion is very severe and regrading is needed to restore the bank, any of the above alternatives would be appropriate. In areas where the lake's edge is not bordering a homeowner's backyard, live planting along the shoreline may suffice to prevent further erosion as this is the least costly alternative. Combinations of limiting factors can further refine the selection of the desired alternative. Finally, the desires of the homeowner will also be a factor into the selection of an alternative.

Subsequent to the review and approval of this report by the Placido Bayou Community Association, a detailed study will be made of all lake edges within the community. The purpose of this second phase of the study will be to assess the condition of the lake edge at all locations and prepare bank restoration recommendations for each of these areas.

V. Specific Restoration Recommendations for Lake Lucerne and Lake Messina

Based on our site inspection, the following specific recommendations are provided. These recommendations are related to the cross sections referenced in the Appendix. The field survey verified that the banks around the perimeter of both lakes have eroded such that the lake edges are several feet landward of their original locations. Without an original as-built survey of the lakes, it is not possible to determine the exact extent of erosion. The extent of erosion is estimated based on the locations of the pipe headwalls within the lake and the trees along the lake bank.

Subsequent to this report, exact limits of the proposed alternatives would be delineated in the field. This would allow for a precise determination of quantities and allow a contractor to prepare a bid for construction/installation. Due to factors such as access, location of work, and quantities of materials, a detailed cost estimate can not be prepared for each of the alternatives at this time. It is recommended that the linear foot estimates provided above be applied to each of the areas to establish magnitude of costs for the recommended alternatives in each of the areas.

Lake Lucerne

On the north side of Lake Lucerne from Cross Section 1 to Cross Section 3, the lake edge can be left in its current condition. Plants should be installed along the water's edge at a dense enough interval to prevent further erosion. Over time the lake edge should stabilize and the planting would reduce further loss of lake bank material. Reshaping of the lake edge is not needed in this area since this a common area with no houses or roads in the immediate vicinity. Estimated cost of plantings would be \$5 per foot over 250 feet.

From Cross Section 3 to Cross Section 4, the lake edge can be left in its current condition with plants installed along the water's edge at a dense enough interval to prevent further erosion. This action should reduce further loss of lake bank material. Estimated cost of the plantings would be \$5 per foot over 120 feet. The lake bank immediately adjacent to the culvert head wall in this area needs to be backfilled and reshaped to its original condition. This area should be stabilized with either the coir fiber matrix system (coir mattress) or the Geoweb cellular confinement system. These methods are recommended due to the steep bank conditions in this area.

In the area between Cross Section 4 and Cross Section 5, it is important to stabilize the lake bank to prevent further erosion. Due to the proximity of the homes in this area, a pre-vegetated plant mat would be the best alternative. In lieu of this alternative, very dense plantings could be installed. Estimated cost of the plantings would be \$5 per foot over 250 feet. If the homeowners in this area do not want herbaceous plants along the lake edge, but rather a manicured lawn to the water's edge, then either the coir fiber matrix system or the Geoweb cellular confinement system should be installed. It is recommended that if either stabilization method is installed, the lake edge should be first reshaped to near its original condition. This would require the import of fill material. Estimated costs for these options would be \$25 to \$100 per linear foot over 250 feet plus the cost of the fill material.

No action is required along the west end of the lake due to the existing dense littoral vegetation in this area. This area has been stabilized from further erosion as a result of the natural process of plant growth.

Lake Messina

On the east side of Lake Messina from Cross Section 1 to Cross Section 2, the lake edge can be left in its current condition. Plants should be installed along the water's edge at a dense enough interval to prevent further erosion. Over time the lake edge should stabilize and the planting would reduce further loss of lake bank material. Reshaping of the lake edge is not needed in this area since this a common area with no houses or roads in the immediate vicinity. Estimated cost of plantings would be \$5 per foot over 320 feet.

On the south side of the lake from Cross Section 2 to Cross Section 5, coir rolls should be installed to prevent further loss of lake bank material. Dense plantings should be provided at the base of the rolls to provide immediate protection of the lake edge. Due to the close proximity of the road in this area, the coir logs are recommended to add greater stability to the lake edge. Estimated costs of the coir logs and plantings would be \$15 per foot over 450 feet. In lieu of the coir logs with plantings, dense plantings can be provided (\$5 per foot). However, if only plants are installed, it is recommended that surveyed control points be installed along the lake edge to record the current bank location. If this bank edge continues to migrate toward the road, then coir logs would need to be installed.

From Cross Section 5 to Cross Section 6, the lake bank should be filled to return the lake edge to its original location. A coir mattress should be installed to stabilize the fill. Estimated cost would be \$25 per foot over 120 feet plus the cost of the fill material. To reduce costs, the lake edge could be left in its current condition, and plants should be installed along the water's edge at a dense enough interval to prevent further erosion (\$5 per foot).

From Cross Section 6 to Cross Section 8 and beyond Cross Section 8 on the west side of the northern leg of the lake, the existing embankment is very steep from the existing buildings to the water's edge. In addition, several large trees are located at the lake edge in this area. If these trees were blown over during a storm, the loss of soil from the root ball could compromise the building foundations in this area. For this reason, it is critical that this area be given priority attention. It is recommended that coir logs should be installed 6 to 10 feet waterward of the lake edge. Fill should be placed behind the coir logs to restore the lake edge. Disturbed areas above the lake edge should sodded, and herbaceous plants should be installed at the edge of the coir logs. This action will provide additional stability to the steep slope in this area. Estimated costs would be higher than typical due to the fill required and the proximity of the buildings. Estimated costs would be upwards of \$50 per foot over 570 feet plus the cost of fill material.

In lieu of the coir logs with fill and plantings between Cross Section 6 and Cross Section 8 and beyond Cross Section 8 on the west side of the northern leg of the lake, dense plantings can be provided along the lake edge. However, if only plants are installed, it is recommended that surveyed control points be installed along the lake edge to record the current bank location. These control points should be monitored on an annual basis. If this bank edge continues to

migrate toward the buildings, then coir logs would need to be installed. In addition, if coir logs are not installed, the trees along the water's edge should be removed to prevent soil loss should they blow over during a storm.



PHOTO 1

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 LB No. 2904
 LC No. 371

EXISTING ERODED SHORE LINE

PLACIDO BAYOU
 PINELLAS COUNTY, FLORIDA

DATE:	07-02-06
SCALE:	AS NOTED
DRAWN BY:	K.E.B.
CHECKED BY:	D.M.V.
PROJ. #	12478
SHT- 1	



PHOTO 2



PHOTO 3

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EXISTING ERODED SHORE LINE

PLACIDO BAYOU
 PINELLAS COUNTY, FLORIDA

DATE:	07-02-08
SCALE:	AS NOTED
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SHT- 2	



PHOTO 4

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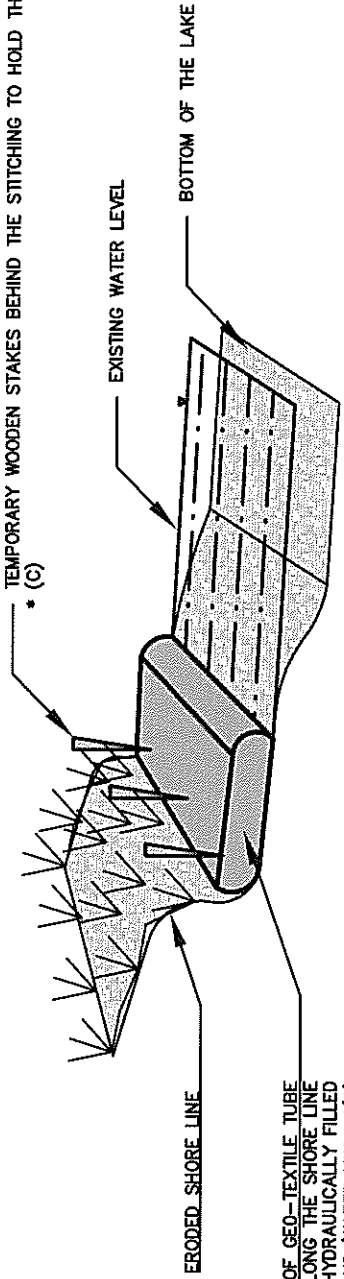
EB No. 2604
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DATE:	07-02-08
SCALE:	AS NOTED
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CHECK. BY:	D.M.V.
PROJ. #	12478
SHT- 3	

CABLE CONCRETE BLOCK LINING

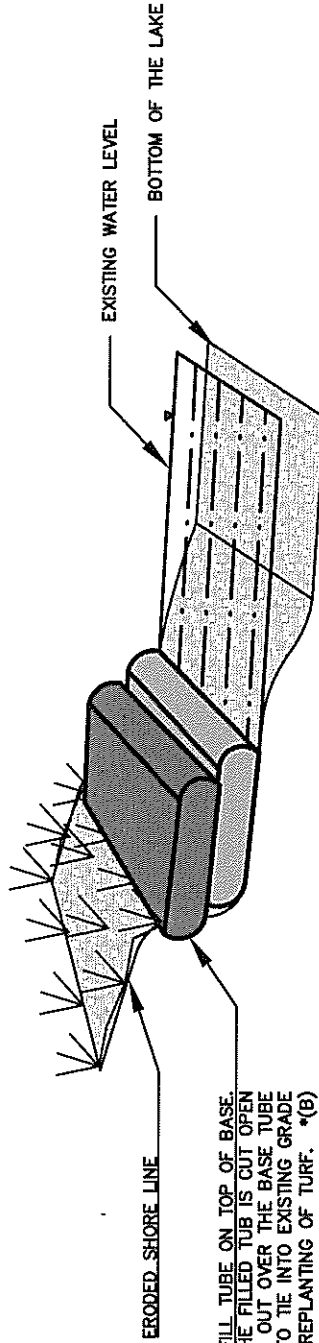
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 PINELLAS COUNTY, FLORIDA

TEMPORARY WOODEN STAKES BEHIND THE STITCHING TO HOLD THE TUBE IN PLACE * (C)



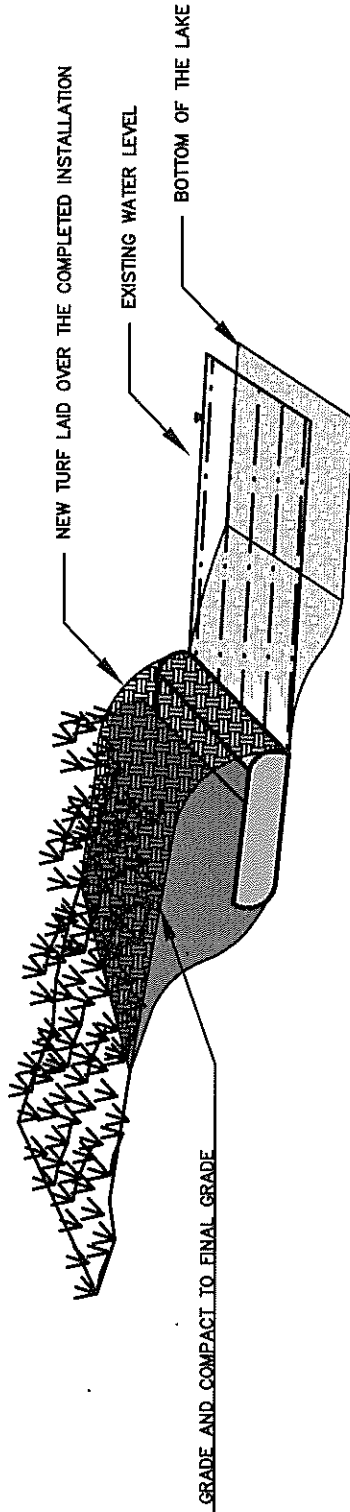
STEP 1

INSTALL A LINE OF GEO-TEXTILE TUBE ALONG THE SHORE LINE THE TUBES ARE HYDRAULICALLY FILLED WITH SAND/WATER MIX. *(A)



STEP 2

INSTALL A FINAL BACK FILL TUBE ON TOP OF BASE. THE FILLED TUB IS CUT OPEN AND THE MATERIAL IS RAKED OUT OVER THE BASE TUBE TO THE INTO EXISTING GRADE IN PREPARATION FOR THE REPLANTING OF TURF. *(B)



STEP 3

*A DREDGE LAKE: CLEAR ORGANIC MATERIAL AND SILT THAT HAS BUILT UP OVERTIME.
 *B IF THE EROSION IS TOO SEVERE MORE THAN ONE TUBE MAY BE REQUIRED.
 *C HIGH RISE WATER LEVEL WOULD BE EXPECTED

<p>ALTERNATIVE 1 GEO TEXTILE TUBE EROSION CONTROL</p>		<p>DATE: 07-02-08 SCALE: AS NOTED DRN. BY: J.C.G. CHK'D. BY: D.M.V. PROJ. # 12478</p>
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<p>PLACIDO BAYOU PINELLAS COUNTY, FLORIDA</p>		<p>EB No. 2904 LB No. 2904 LC No. 371</p>
<p>SHT-4</p>		



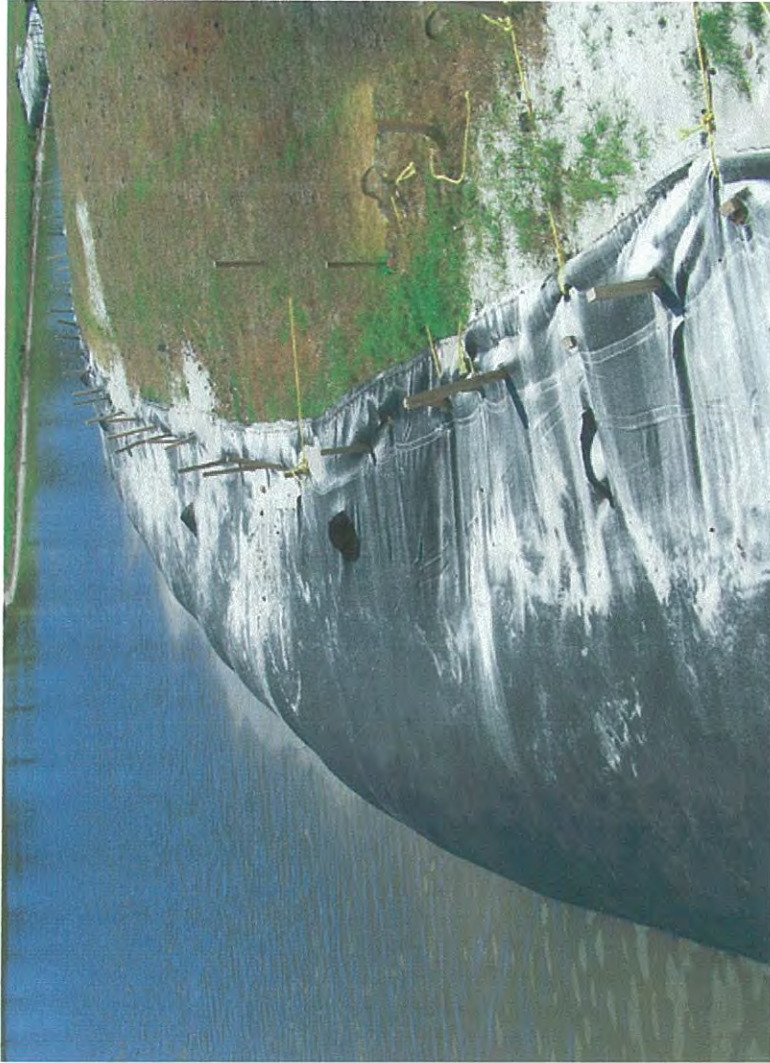


PHOTO 5

STEP 1- INSTALL A LINE OF GEO-TEXTILE TUBE AND TEMPRARY STAKES

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DATE:	07-02-08
SCALE:	AS NOTED
DRN. BY:	K.J.B.
CHECK. BY:	D.M.V.
PROJ. #	12478
SHT- 5	

GEO-TEXTILE TUBE

PLACIDO BAYOU
 PINELLAS COUNTY, FLORIDA



PHOTO 6

STEP 2- INSTALL A FINAL BACK FILL TUBE ON TOP



PHOTO 7
STEP -3 FINAL

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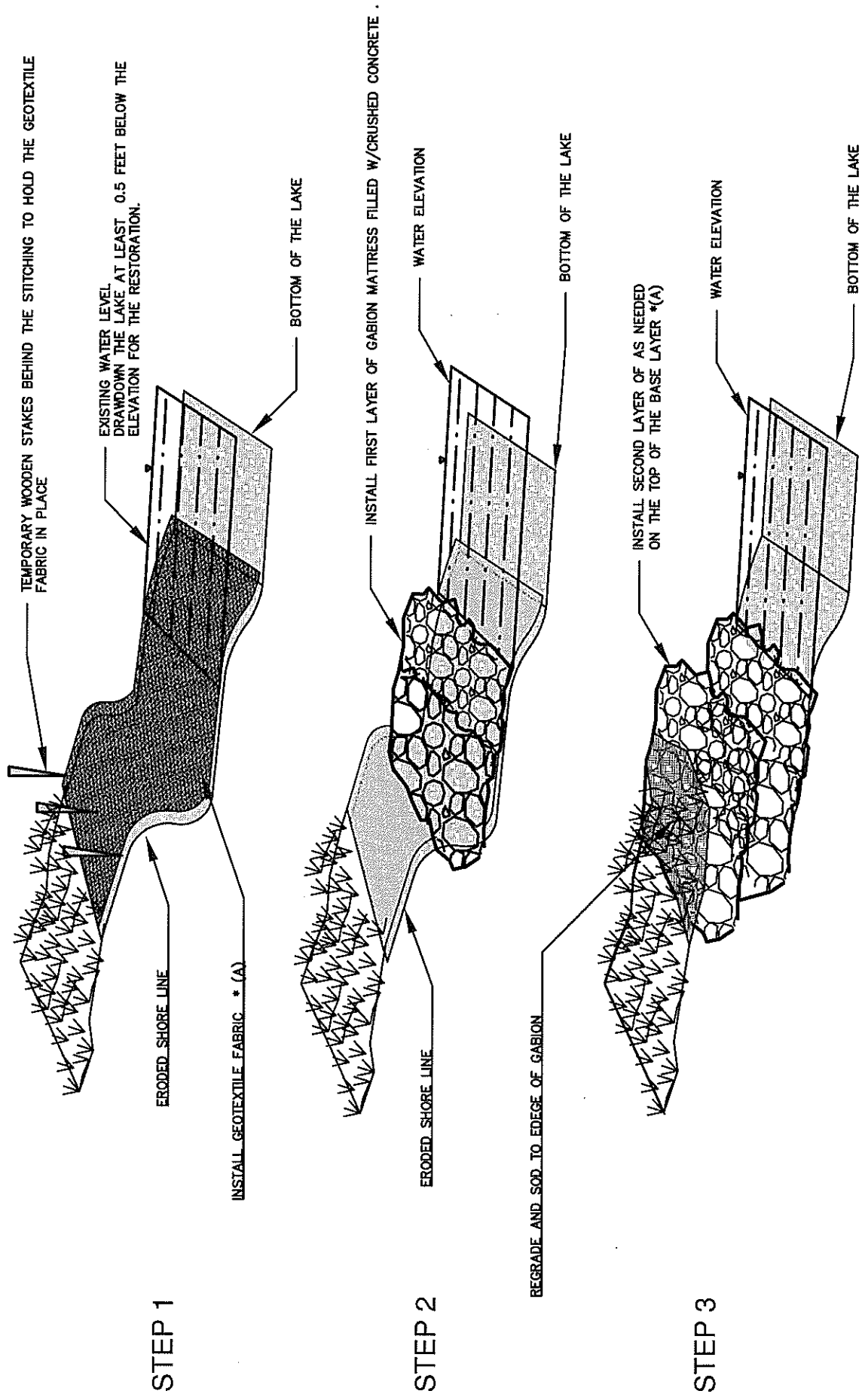


GEO-TEXTILE TUBE

PLACIDO BAYOU
PINELLAS COUNTY, FLORIDA

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SHT- 6



*A IF THE EROSION IS TO SEVERE MORE THAN ONE LAYER MIGHT BE NECESSARY.

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ALTERNATIVE 2
GABION MATTRESSES WITH VEGETATION
PLACIDO BAYOU
 PINELLAS COUNTY, FLORIDA

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PHOTO 8

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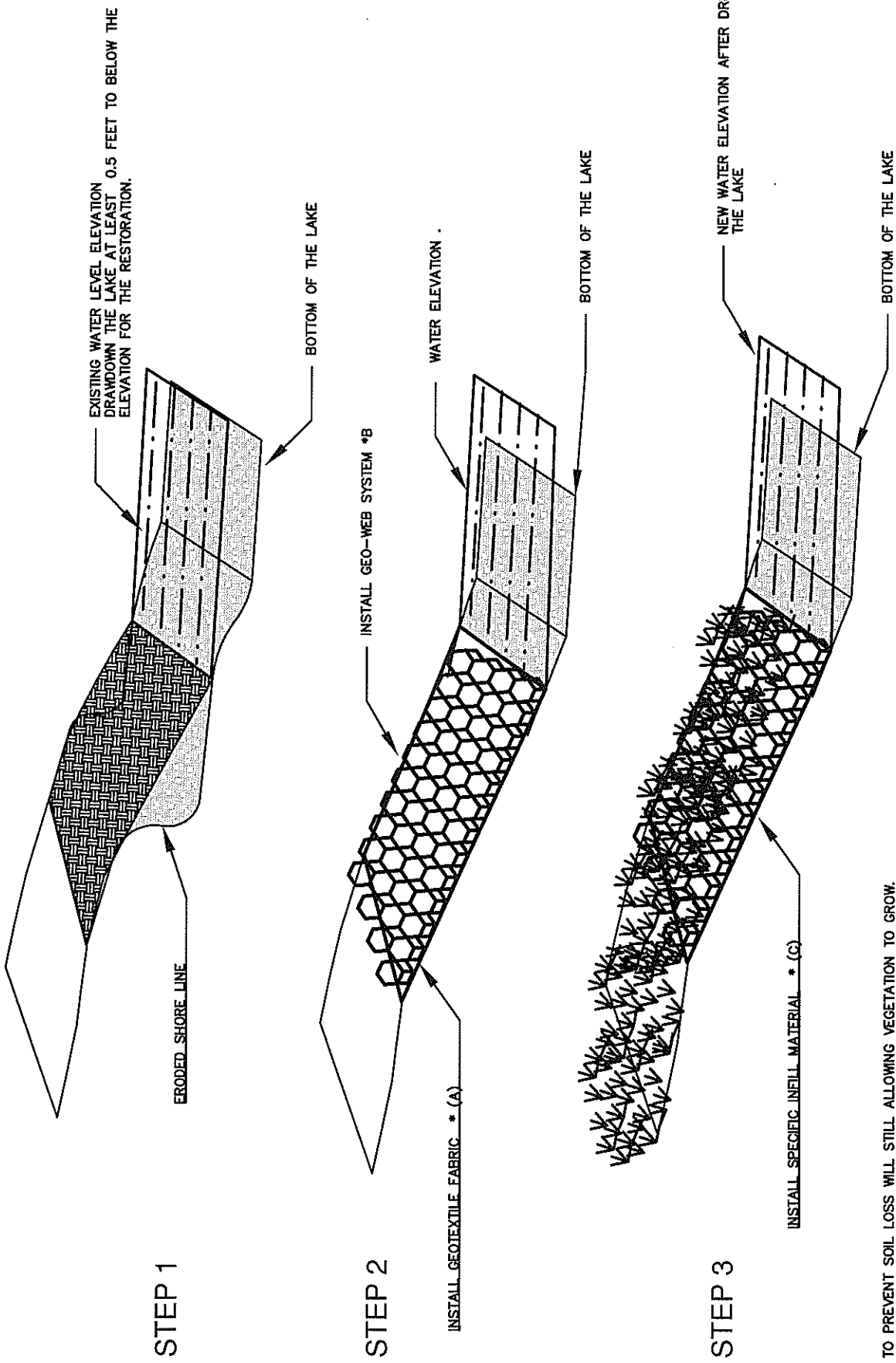
EB No. 2604
 LB No. 2904
 LC No. 371



DATE:	07-02-08
SCALE:	AS NOTED
DRN. BY:	K.E.S.
CHKD. BY:	D.M.V.
PROJ. #	12478
SHT- 8	

GABION BASKETS AND WIRE MATTRESSES W/VEGETATION

PLACIDO BAYOU
 PINELLAS COUNTY, FLORIDA



*A TO PREVENT SOIL LOSS WILL STILL ALLOWING VEGETATION TO GROW.
 *B SEE ATTACHED SPECIFICATIONS FROM THE MANUFACTURER.
 *C IN FILL MATERIALS: -AGGREGATE FROM SAND AND GRAVEL TO 1/2" ROCK OR CRUSHED CONCRETE


ALTERNATIVE 3 GEOWEB CELLULAR CONFINEMENT SYSTEM		DATE: 07-02-08 SCALE: AS NOTED DRN. BY: I.C.G. CHKT. BY: D.M.V.
PLACIDO BAYOU PINELLAS COUNTY, FLORIDA		PROJ. # 12478 SHT-9
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PHOTO 9

STEP 2- DURING RESTORATION



PHOTO 10

STEP 3- FINAL

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 Fax No. (813) 289-5365

EB No. 2604
 LB No. 2504
 LC No. 371

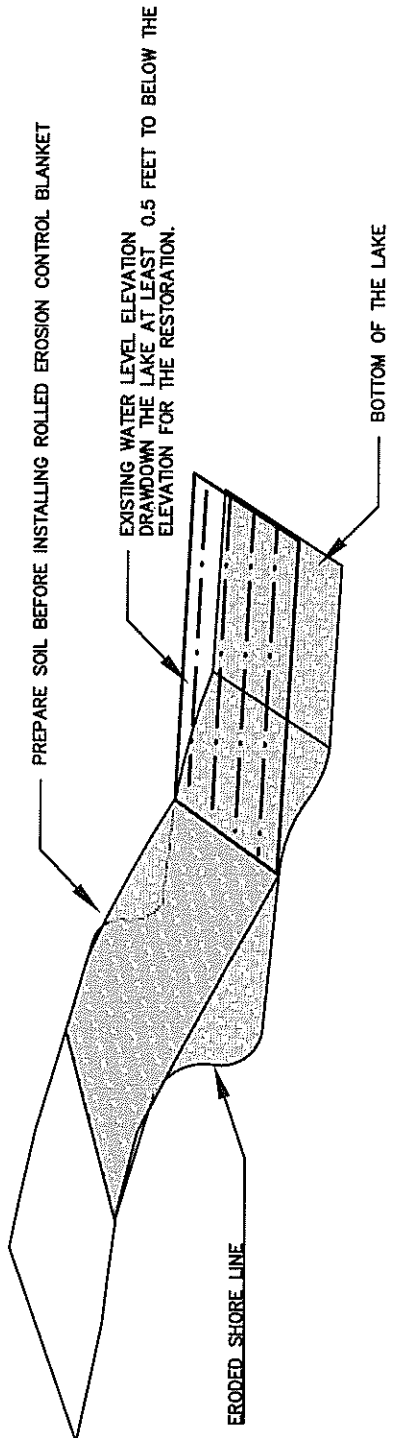


GEO WEB CELLULAR CONFINEMENT SYSTEM

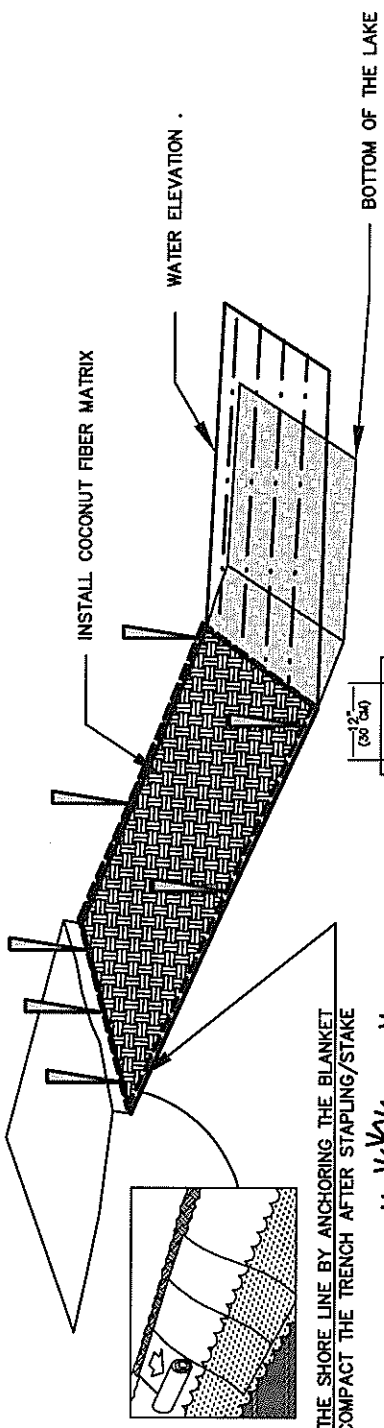
PLACIDO BAYOU
 PINELLAS COUNTY, FLORIDA

DATE: 07-02-08
 SCALE: AS NOTED
 DRN. BY: K.E.E.
 CHKD. BY: D.M.V.
 PROJ. # 12478

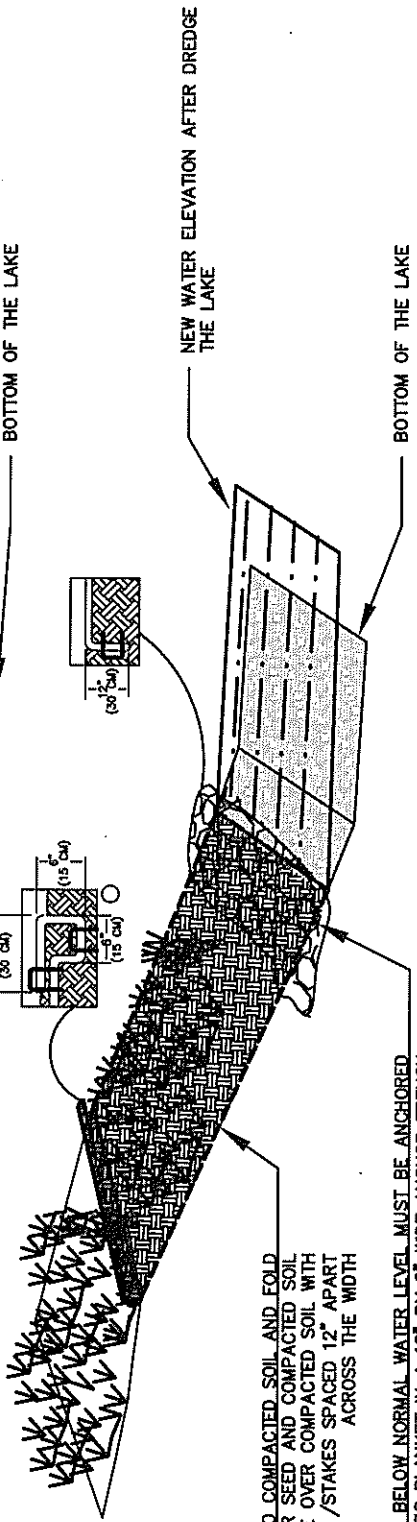
SHT-10



STEP 1



STEP 2



STEP 3

BEGIN AT THE TOP OF THE SHORE LINE BY ANCHORING THE BLANKET BACKFILL AND COMPACT THE TRENCH AFTER STAPLING/STAKE

APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING PORTION BACK OVER SEED AND COMPACTED SOIL SECURE OVER COMPACTED SOIL WITH A ROW OF STAPLES /STAKES SPACED 12" APART ACROSS THE WIDTH

THE EDGE OF THE BLANKET OR BELOW NORMAL WATER LEVEL MUST BE ANCHORED BY PLACING THE SPECIFIC BLANKET IN A 12" BY 6" WIDE ANCHOR TRENCH BACK FILL AND COMPACT USING STONE OR SOIL

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ALTERNATIVE 4
 COIR COCONUT FIBER MATRIX (BLANKET)

PLACIDO BAYOU
 PINELLAS COUNTY, FLORIDA

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SCALE:	AS NOTED
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CHKD. BY:	D.M.V.
PROJ. #	12478
SHT-11	

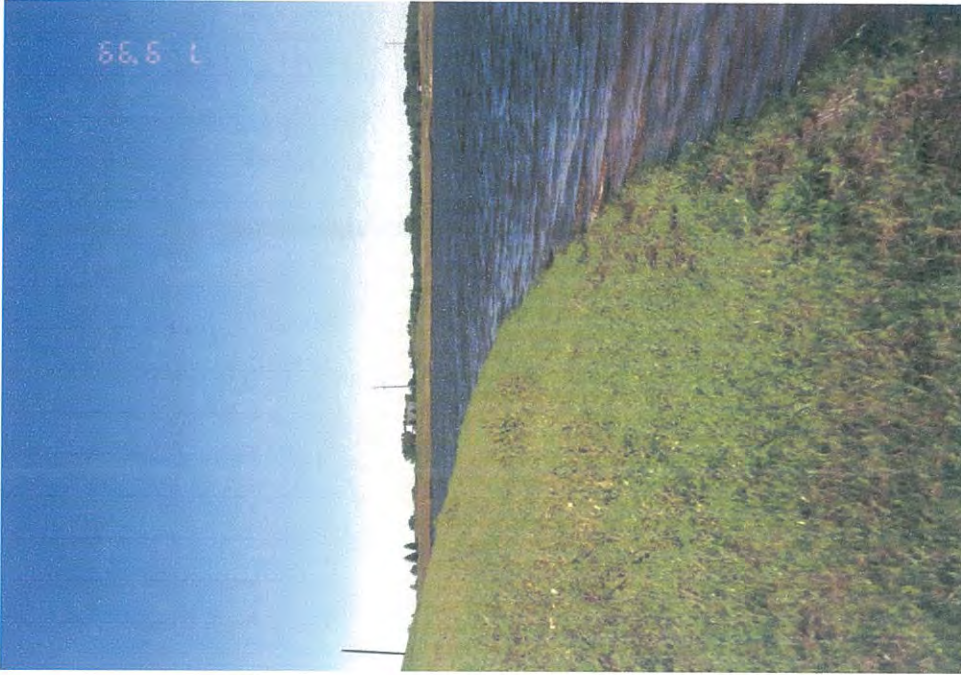


PHOTO 12

STEP 3- FINAL



PHOTO 11

STEP 2- DURING RESTORATION

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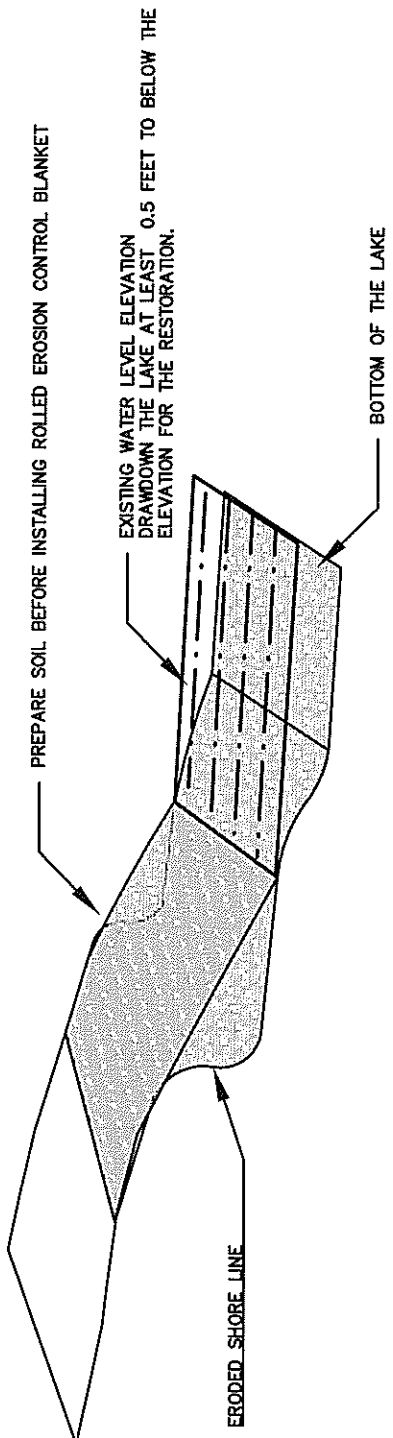
EB No. 2804
 LB No. 5204
 LC No. 371

NORTH AMERICAN GREEN - COCONUT FIBER MATRIX

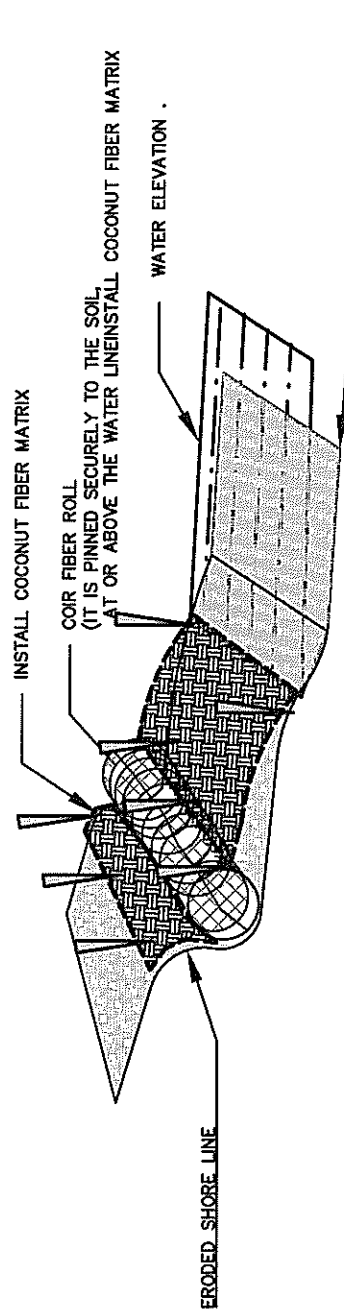
PLACIDO BAYOU
 PINELLAS COUNTY, FLORIDA

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CHECKED BY:	D.M.V.
PROJ. #	12478

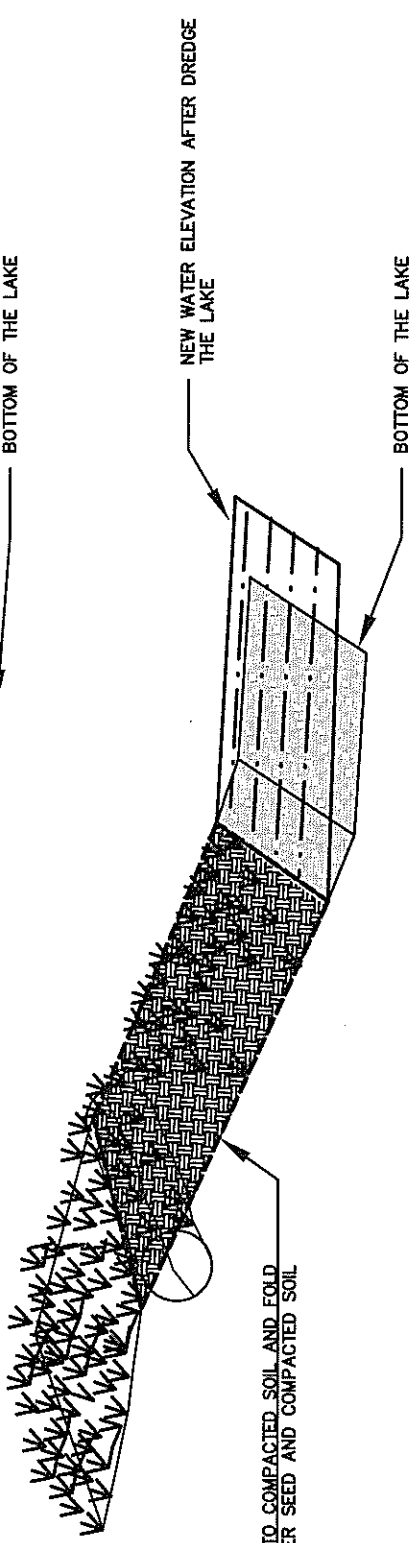
SHT-12



STEP 1



STEP 2



STEP 3


<p>ALTERNATIVE 5 COIR ROLL (TURTLE LOGS)</p>		<p>DATE: 07-02-08 SCALE: AS NOTED DRN. BY: I.C.G. CHK'D. BY: D.M.V. PROJ. # 12478</p>
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		<p>SHT-13</p>



PHOTO 13

DURING RESTORATION

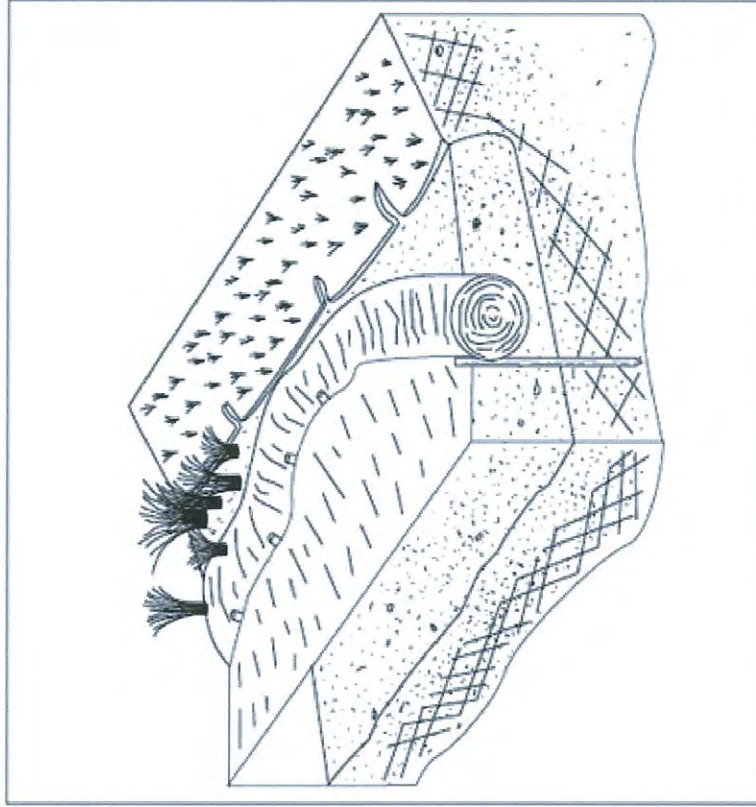


PHOTO 14

SCHEMATIC

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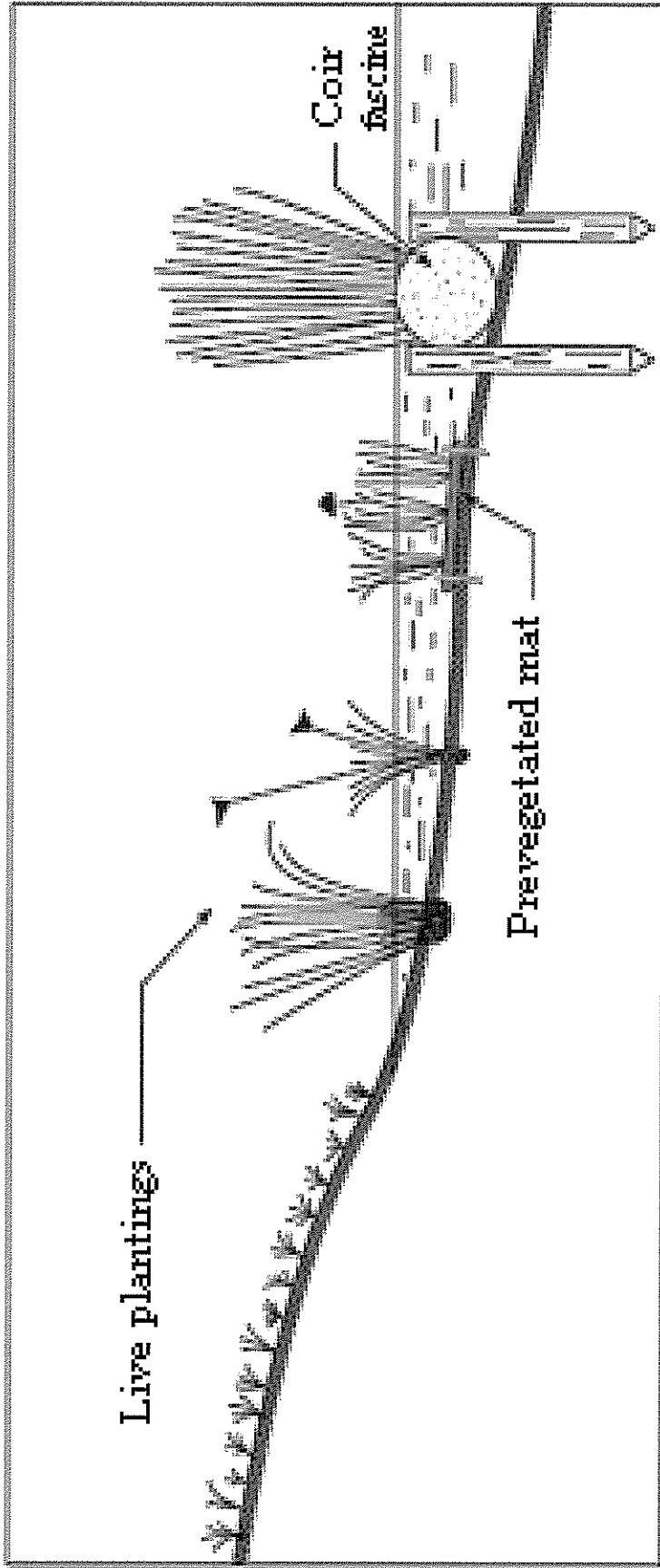


COIR ROLL (TURTLE LOGS)

PLACIDO BAYOU
 PINELLAS COUNTY, FLORIDA

DATE: 07-02-06
 SCALE: AS NOTED
 DRN. BY: K.L.B.
 CHECK. BY: D.M.V.
 PROJ. # 12478

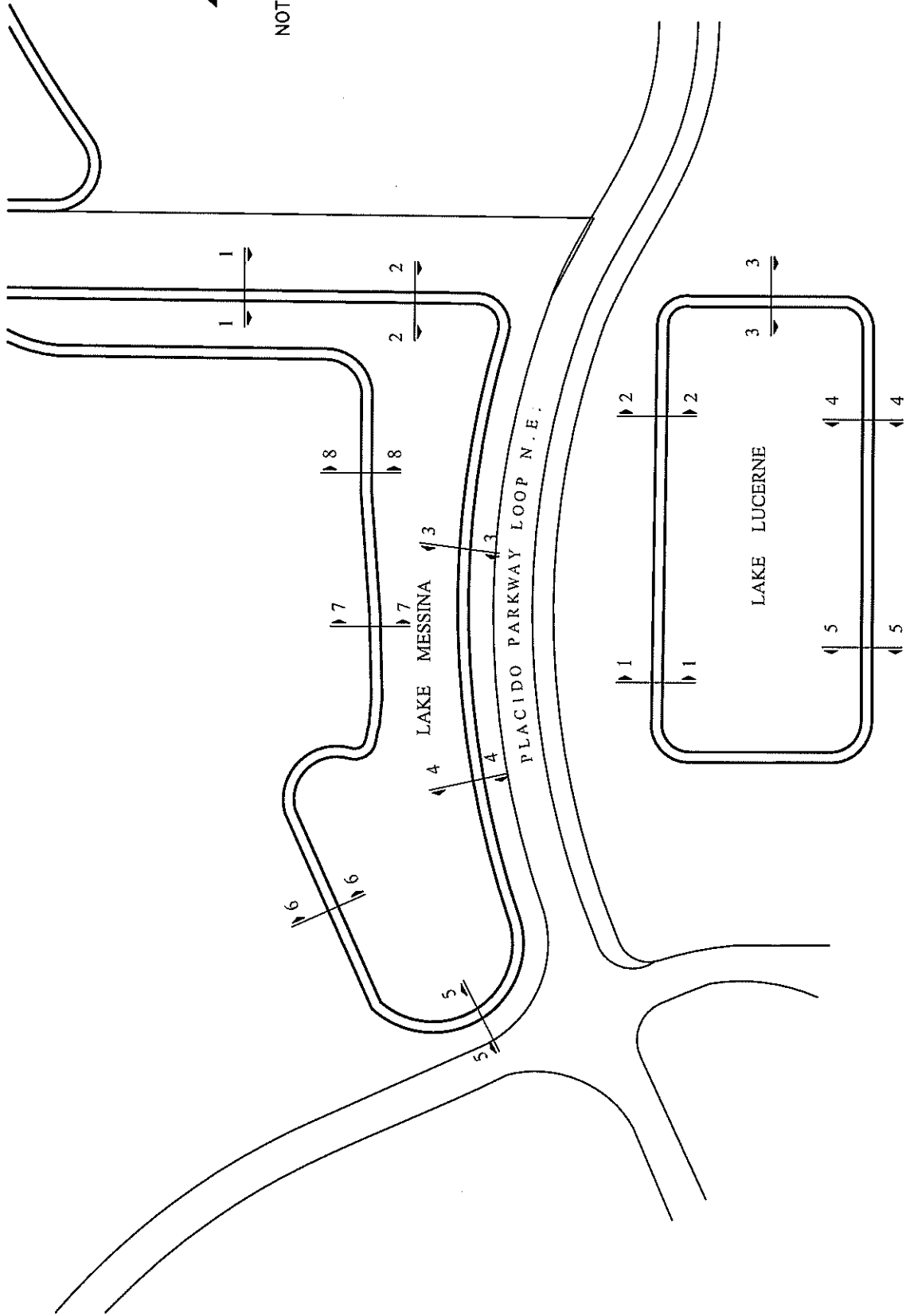
SHT- 14



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	LIVE PLANTING AND PRE-VEGETATED MAT AND COIR ROLL PLACIDO BAYOU PINELLAS COUNTY, FLORIDA



APPENDIX



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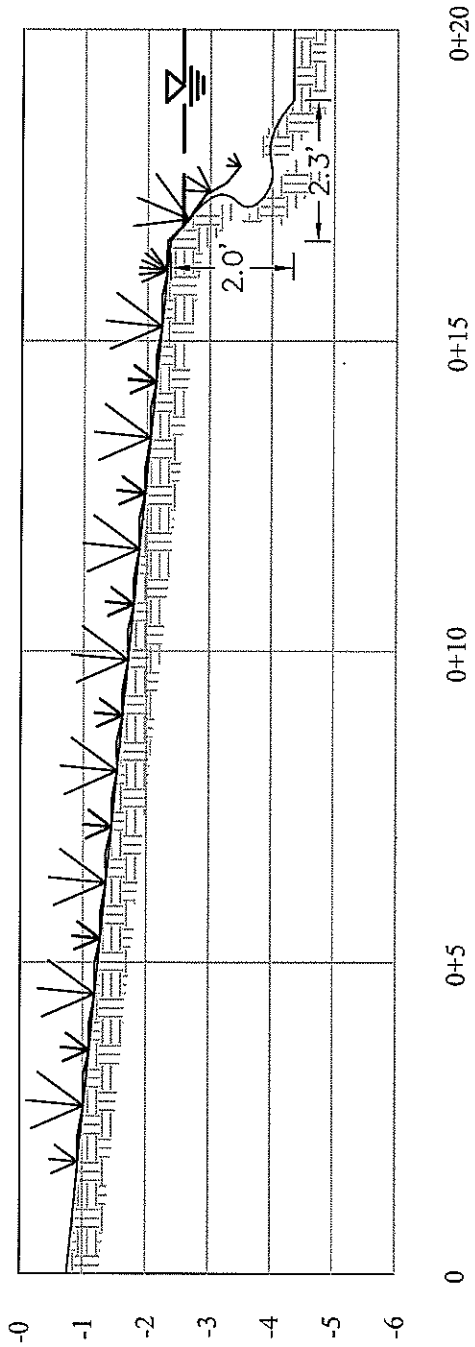
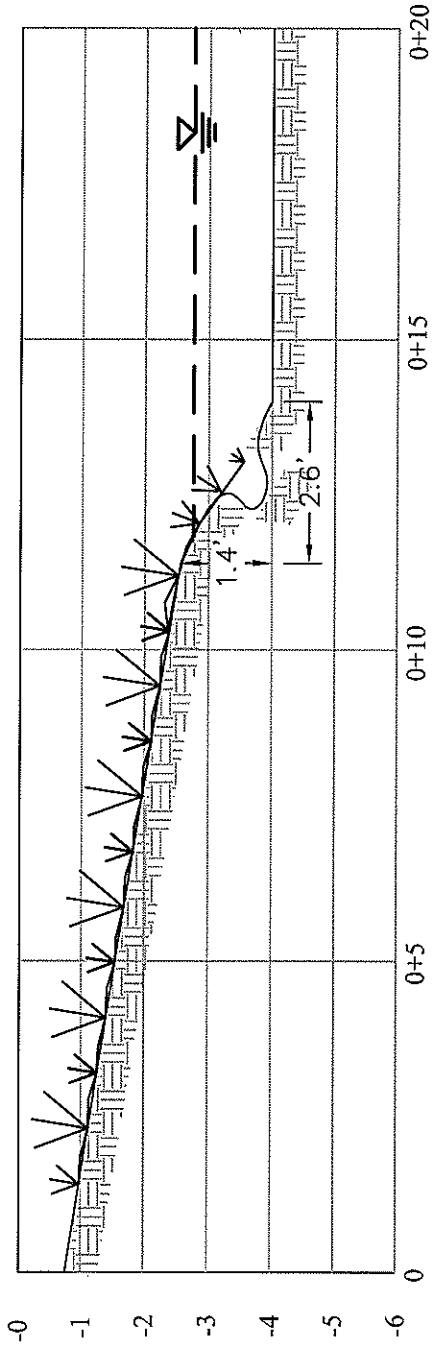


KEY MAP

LAKE BANK RESTORATION & STABILIZATION

PLACIDO BAYOU
 PINELLAS COUNTY, FLORIDA

DATE:	07-08-08
SCALE:	AS NOTED
DRN BY:	L.C.G.
CHK'D BY:	D.M.V.
PROJ. #	12478
SHT-A1	




DATE:	07-02-08
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CHK'D. BY:	D.M.V.
PROJ. #	12478

LAKE SECTIONS
LAKE BANK RESTORATION & STABILIZATION
PLACIDO BAYOU
PINELLAS COUNTY, FLORIDA

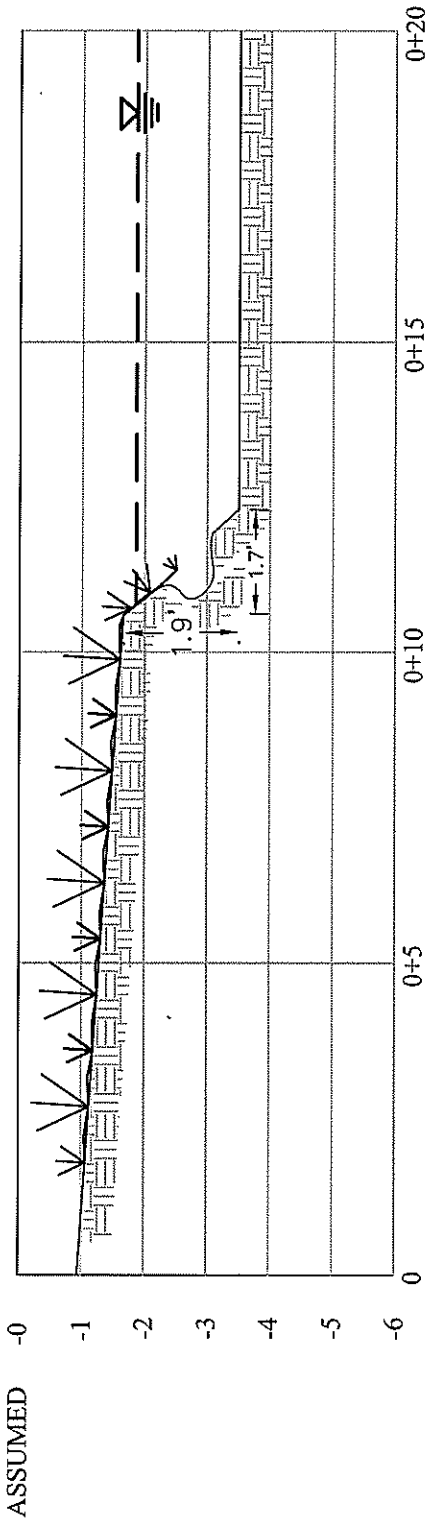
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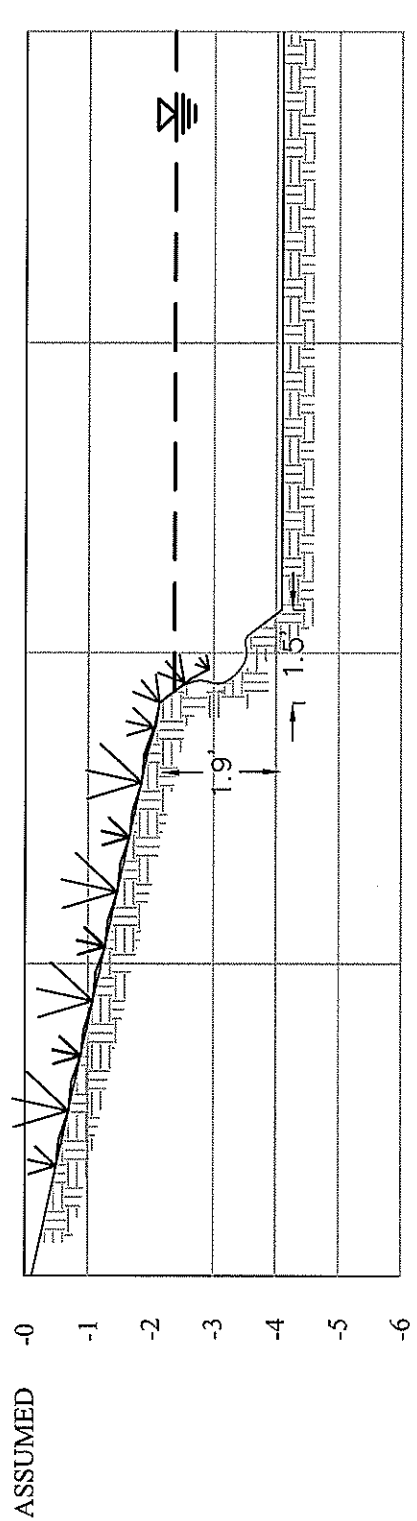
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LC No. 371



SHT-A2



LAKE LUCERNE
CROSS SECTION-3

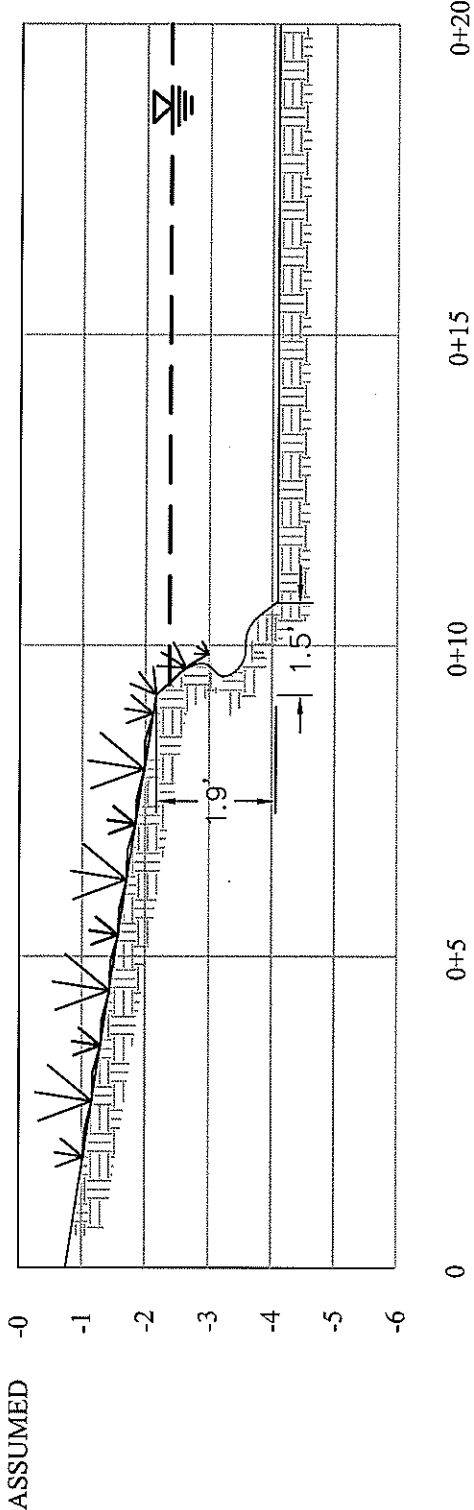


LAKE LUCERNE
CROSS SECTION-4

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LAKE SECTIONS
LAKE BANK RESTORATION & STABILIZATION
PLACIDO BAYOU
PINELLAS COUNTY, FLORIDA

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SHT-A3	

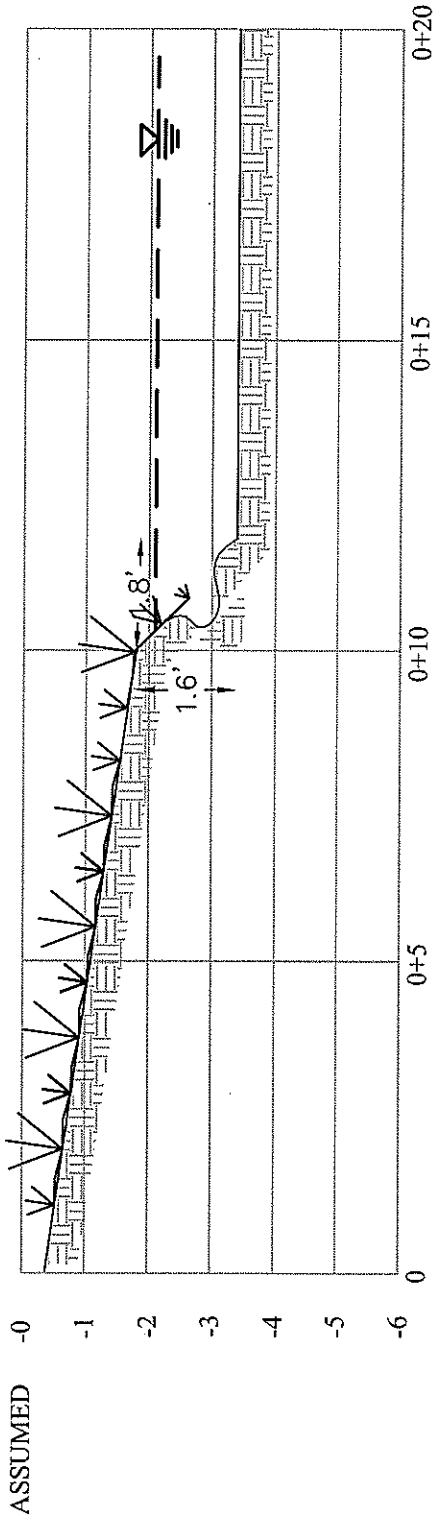


LAKE LUCERNE
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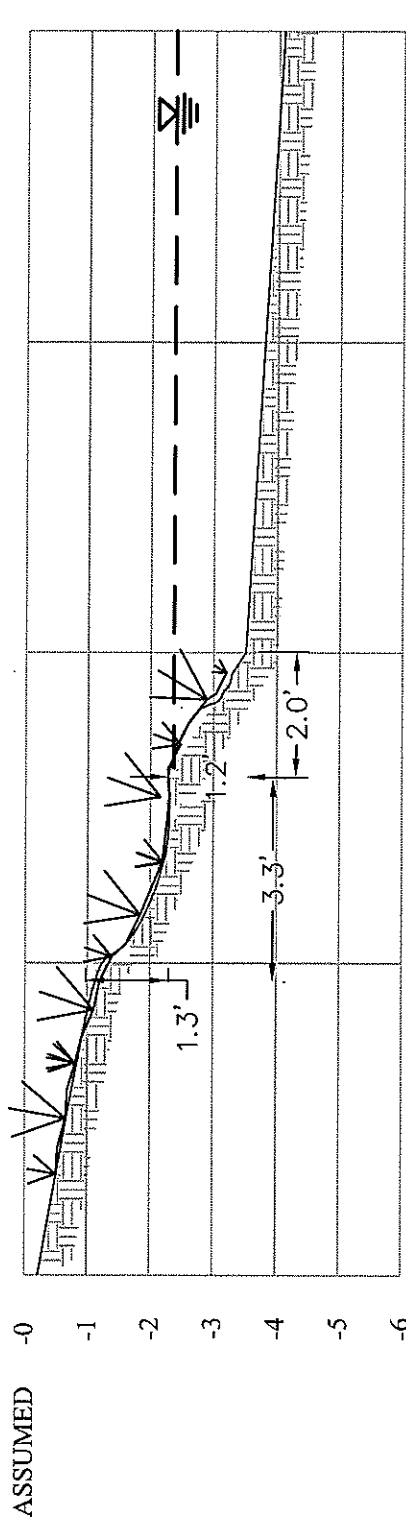
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 PINELLAS COUNTY, FLORIDA

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LAKE MESSINA
CROSS SECTION-1



LAKE MESSINA
CROSS SECTION-2

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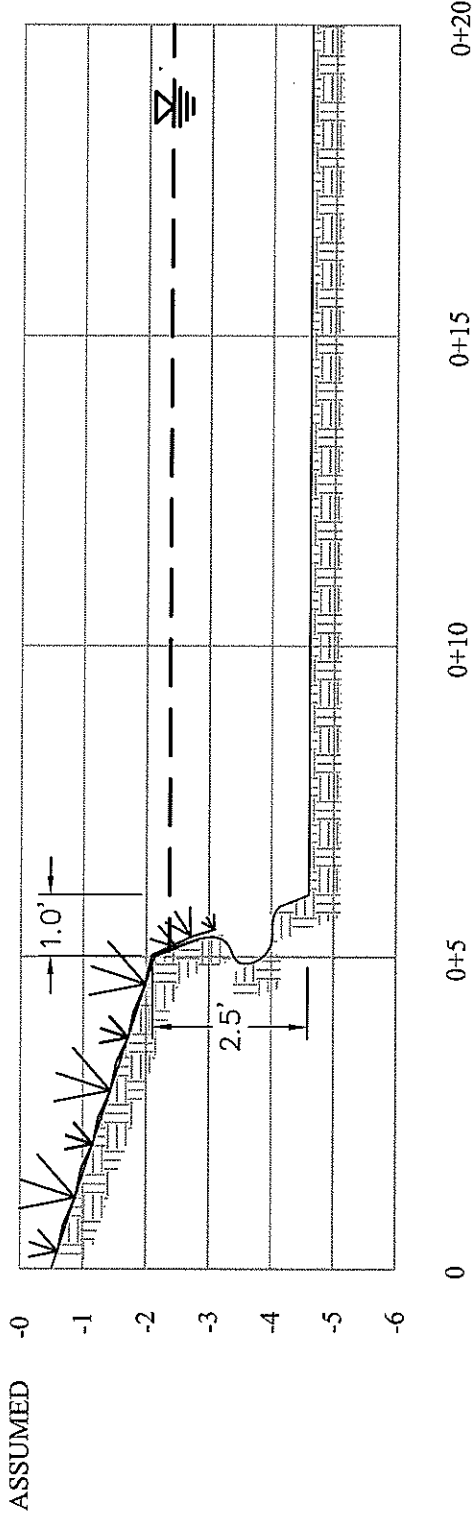
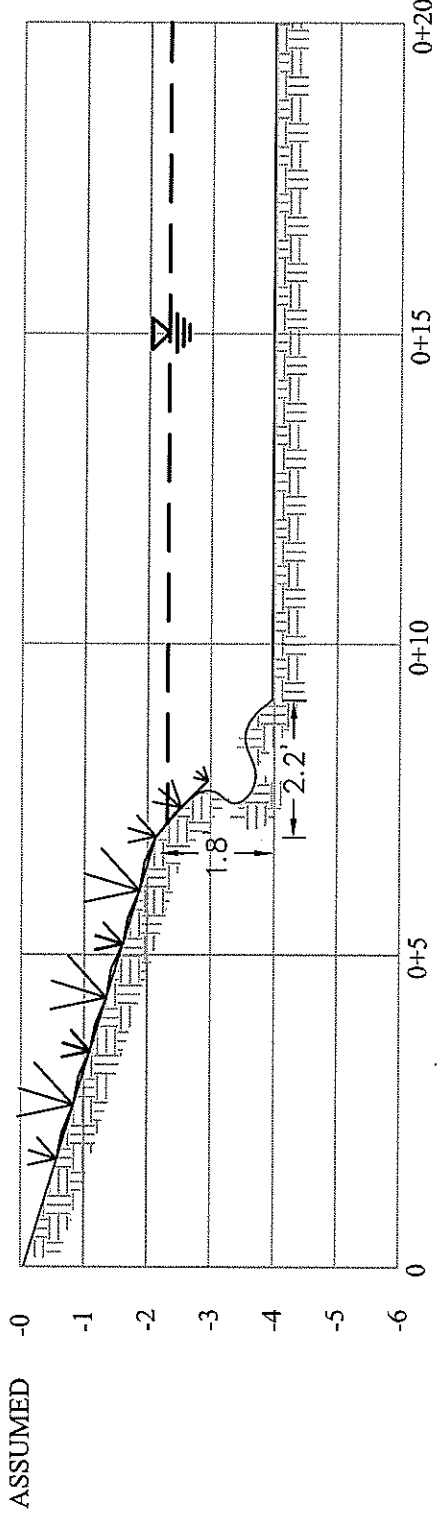
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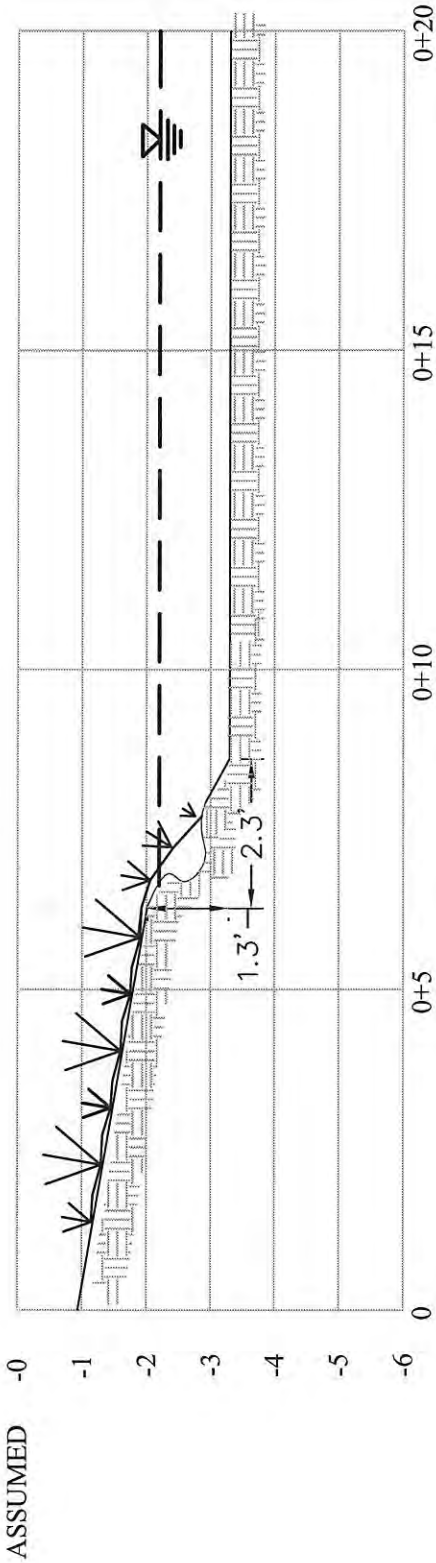
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SHT-A5	



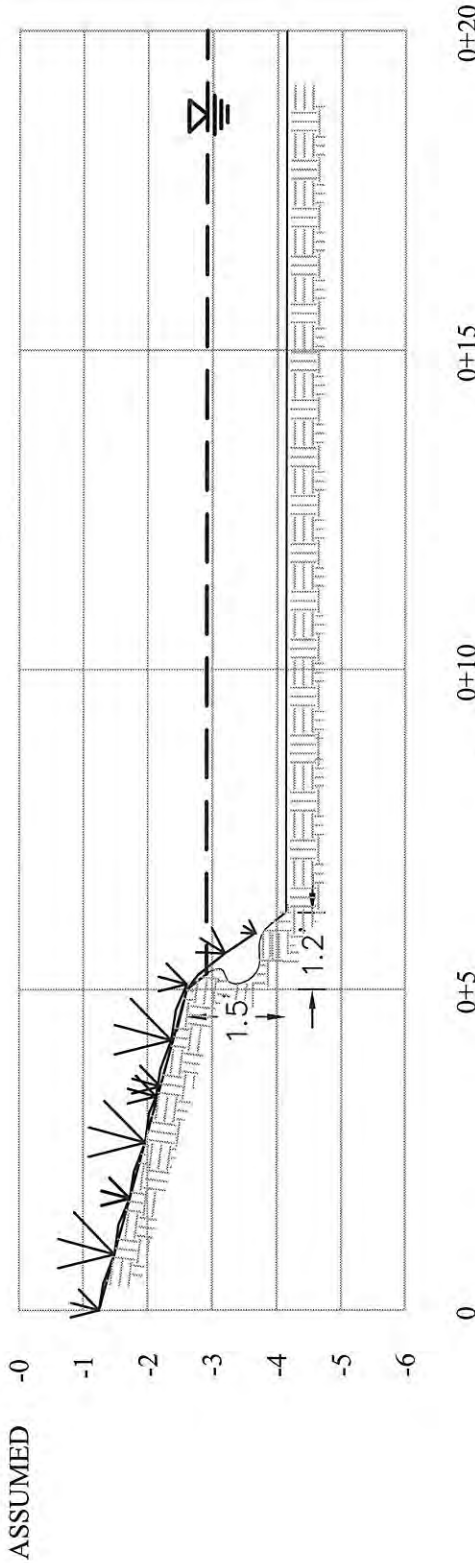
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 PINELLAS COUNTY, FLORIDA

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PROJ. #	12478
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LAKE MESSINA
CROSS SECTION-5

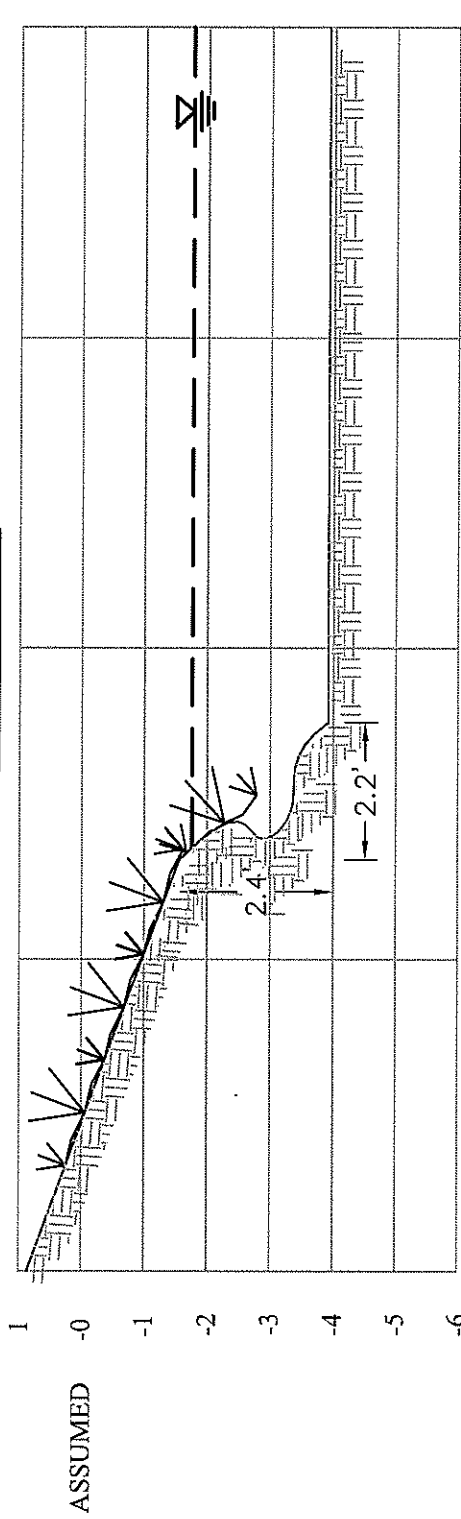
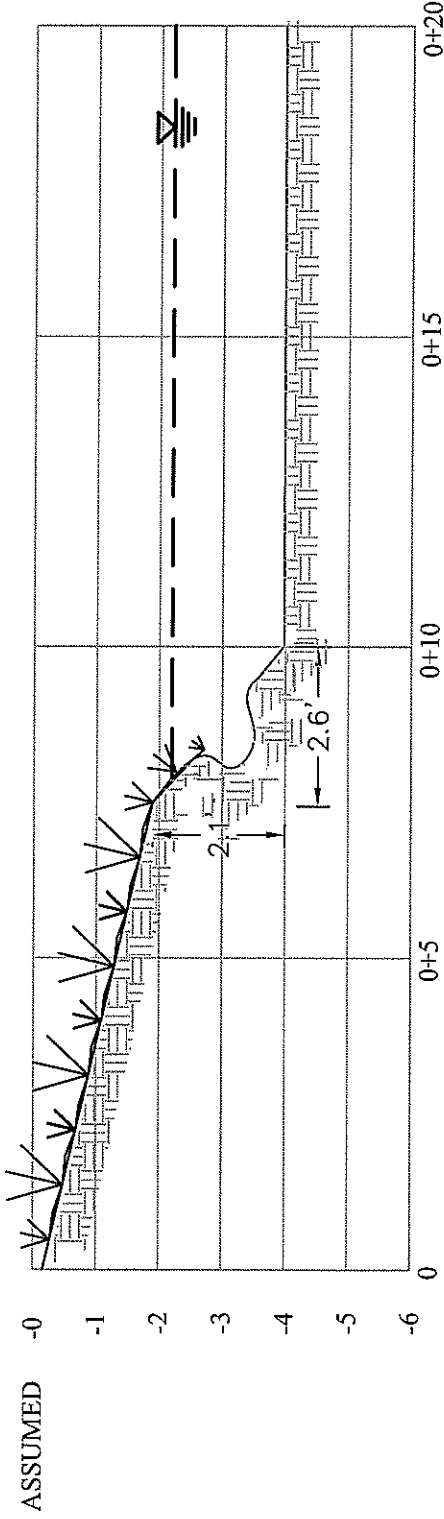


LAKE MESSINA
CROSS SECTION-6

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PLACIDO BAYOU
 PINELLAS COUNTY, FLORIDA

DATE:	07-02-08
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CHK'D. BY:	D.M.V.
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PLACIDO BAYOU
 PINELLAS COUNTY, FLORIDA

DATE:	07-02-08
SCALE:	AS NOTED
DRN. BY:	J.C.G.
CHKD. BY:	D.M.V.
PROJ. #	12478
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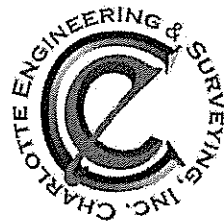
PLACIDO BAYOU

Lake Bank Restoration and Stabilization

REPORT - PHASE II

PREPARED FOR:

PLACIDO BAYOU LAKE COMMITTEE
ST. PETERSBURG, FLORIDA



**CHARLOTTE ENGINEERING
& SURVEYING, INC.**

5410 MARINER STREET, SUITE 125
TAMPA, FL 33609

OCTOBER, 2008

PLACIDO BAYOU LAKE BANK RESTORATION AND STABILIZATION

PHASE II REPORT

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F. Lake Sandpiper	11
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APPENDIX

Placido Bayou Lake Bank Restoration and Stabilization
Phase II Report

I. Background and Purpose

The construction of the Placido Bayou development involved the excavation of several lakes. These lakes were excavated for borrow material to fill the land to a suitable elevation for development. The lakes were integrated into the layout of the development to provide amenity features. Upon completion of the excavation, the edges of the lakes were left in an unprotected condition with landscaped St. Augustine grass extending to the lake edge; no littoral planting zone for shoreline erosion protection was provided.

Over the years, the natural process of continued bank erosion has occurred. In many locations, the edges of the lakes have expanded by 10 feet or more beyond the original bank edge. Due to the lack of protection, the bank at the water's edge and is being continually undermined by the wave action on the lake. This results in a slow but continued collapse of the lake edge as well as its outward migration. The erosion is also impacting the culvert headwalls in the lake. In several of the lakes, the impact was so extensive that significant sections of backyards were being lost to erosion. In order to prevent further erosion, the edges of the lakes in many areas have been protected with seawalls. This provides a hard edge to the lakes with no opportunity for vegetation to grow at the waters edge.

As the erosion is ongoing in the lakes, the Placido Bayou Community Association has taken action to evaluate possible methods, other than constructing seawalls, to stabilize the banks. Charlotte Engineering was contracted to study the lakes and provide alternatives for bank stabilization and restoration. A pilot study (Phase I) was completed for Lake Messina and Lake Lucerne to evaluate these lakes and present findings and recommendations for stabilization and restoration. This pilot study report was completed in August 2008 and submitted to the PBCA. Subsequently, the PBCA authorized Phase II of the project. Prior to initiating Phase II of the project, a work plan was discussed and approved by the PBCA.

The purpose of the Phase II study is to continue the evaluation that was begun in Phase I for the remainder of the lakes in Placido Bayou and provide a detailed report with specific recommendations for lake bank stabilization and restoration throughout the development. In preparing the recommendations, several factors were considered. These included cost, reliability, safety, constructability, access and aesthetics. As stated in the Phase I report, each method of stabilization/restoration has its advantages and disadvantages with respect to cost, maintenance and long term performance. In addition, the stabilization and restoration will, in many cases, require the combined application of alternatives depending on the particular area conditions such as access, constructability, and proximity of structures along the lake bank.

II. Proposed Work Scope

In order to document the extent of the lake bank erosion and to develop recommendations for bank stabilization and restoration, Charlotte Engineering conducted a detailed field investigation of Lake Taranto, Lake Placido, Lake Constance, Lake Heron, Lake Sandpiper, Lake Flamingo and Lake Cypress. To organize the recommendations, each lake was subdivided into segments with similar lake bank characteristics and problems as determined in the field. These segments are shown on the graphics developed for each lake, along with their related recommendations. In addition, photographs were taken to document existing conditions. Photographs are provided in conjunction with the graphics of each segment of the lake banks in order to visually demonstrate the site condition.

For each of the lake bank segments, more than one alternative for stabilization and/or restoration is recommended. Final selection of an alternative will vary for each segment depending, not only on the specific characteristics of the segment and the cost of the alternative, but also the desires of the homeowner in that area. For example, in many areas, dense shoreline plantings would be the only action needed to stabilize the shoreline from further erosion. However, in certain instances, the homeowners along a segment may not want herbaceous plants along the lake edge, but rather a manicured lawn to the water's edge. In these cases, either the Geotextile tube system, the Geoweb cellular confinement system, the coir fiber matrix system, or the coir rolls system (turtle logs) may have to be installed.

During the field investigation of the lake banks, it was noted that a recent die-off in fish population had occurred in several of the lakes. In addition, areas of shoreline plantings appeared stressed. This is likely due to salt water inflow that resulted from the very high tide conditions created during the passage of Hurricane Ike. Also, it appears that some of the stress may be related to low dissolved oxygen in the water due to decay of shoreline plant materials, submerged vegetation and lawn grass clippings floating in the lakes. These conditions are beyond the scope of this report, but should be monitored to maintain healthy lakes and good water quality.

As expected, the field investigation confirmed that the lake banks at the water's edge are near vertical in most areas and are continuing to fail. In addition, if erosion continues unchecked, structures close to the shoreline will eventually be impacted. Presented in the following section are specific recommendations, based on the data collected in the field, and the factors related to access, cost, reliability, safety, constructability, and aesthetics for each lake bank segment.

III. Lake Bank Restoration Recommendations

As discussed in the Phase I report, the cost for the stabilization / restoration along each segment will vary depending on the alternative that is selected. Relative costs per linear foot for each alternative were provided in the Phase I report. Since dense plantings would be the most cost effective alternative for bank stabilization, this method is the first choice of the alternatives presented below. However, for the segments where only plants are installed, it is recommended that surveyed control points be installed along the lake edge to record the current bank location. If the bank edge continues to migrate toward the road, then additional stabilization measures would need to be installed.

A. Lake Constance

Segment 1: The edge of the lake in this segment is moderately eroded; no structures or roads are in immediate risk. Dense planting and a pre-vegetated plant mat or the coir fiber matrix system should be installed to prevent further loss of bank material.

Segment 2: A residential structure is in close proximity to the lake edge along this segment of the lake. The erosion in this area has created a 3 foot vertical drop at the water's edge. As a result of these conditions, this area needs to be both stabilized and restored. The installation of either the Geotextile tube system, the Geoweb cellular confinement system, or the coir rolls system (turtle logs) with a pre-vegetated plant mat is recommended. Additional fill should be added in this area to restore the lake bank to near original conditions. This area has adequate room for construction access.

Segment 3: No structures are in immediate risk at this time although it is evident that the lake edge has moved back several feet over the past years. The lake bank in this area has a 2 to 3 foot vertical drop at the water's edge. In addition, the slopes of the backyards in this area are fairly steep. As a result, this area should be both stabilized and restored. The installation of either the Geotextile tube system, the Geoweb cellular confinement system, or the coir rolls system (turtle logs) with a pre-vegetated plant mat is recommended. Additional fill should be added in this area to restore the lake bank to near original conditions. This area has limited room for construction access through Segment 2. It was also noted that the headwall structure in this area appears to be displaced and should be stabilized.

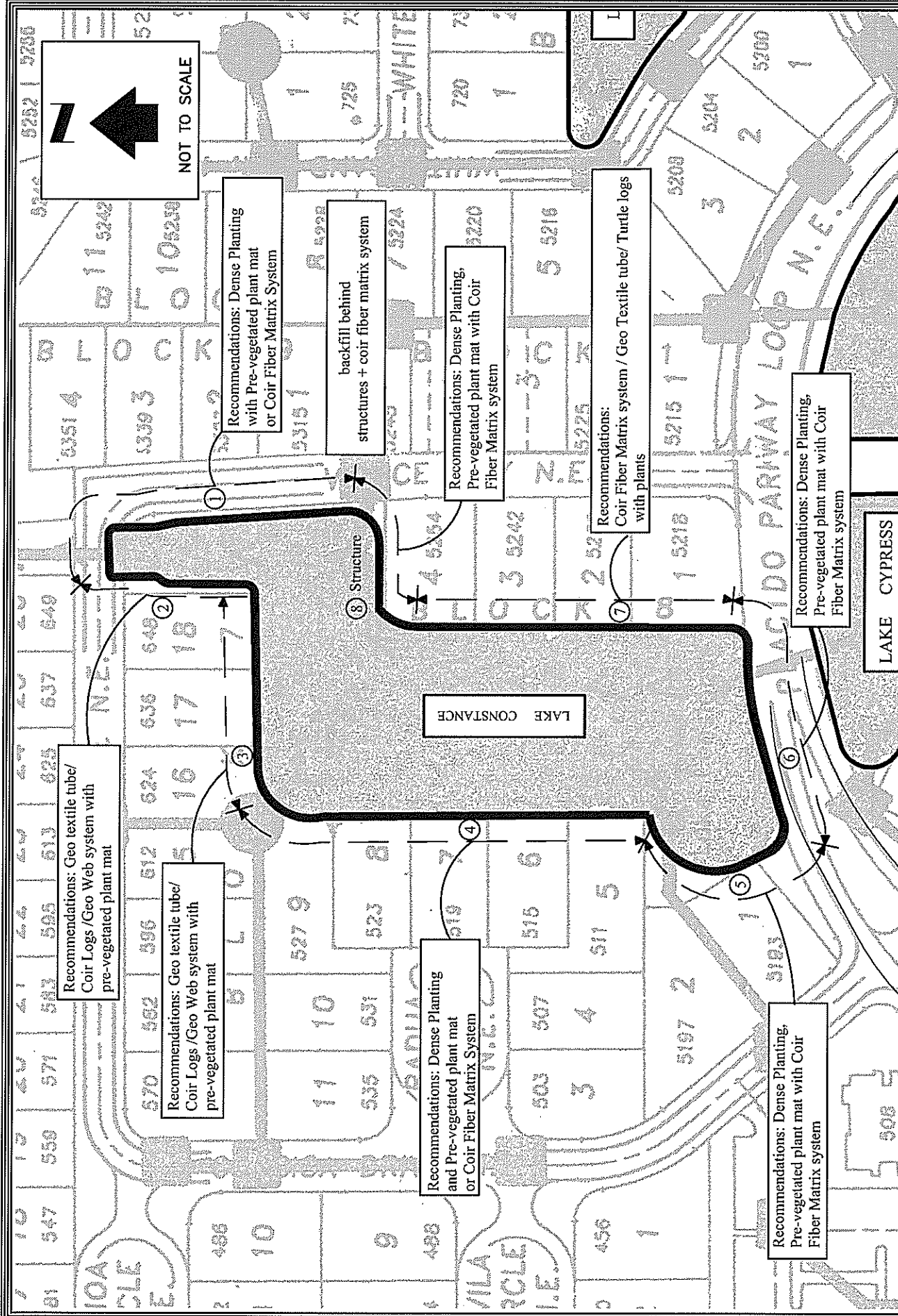
Segment 4: The edge of the lake in this segment is moderately eroded. No structures are in immediate risk and the backyard slopes in this segment are not as steep as the backyard slopes in Segment 3. Due to these conditions, dense planting and a pre-vegetated plant mat or the coir fiber matrix system should be installed to prevent further loss of bank material.

Segment 5: The edge of the lake in this segment is moderately eroded. No structures are in immediate risk and the backyard slopes in this segment are not as steep as the backyard slopes in Segment 3. Due to these conditions, dense planting and a pre-vegetated plant mat or the coir fiber matrix system should be installed to prevent further loss of bank material.

Segment 6: The edge of the lake in this segment is moderately eroded; the road along this segment is not in immediate risk. Dense planting and a pre-vegetated plant mat or the coir fiber matrix system should be installed to prevent further loss of bank material.

Segment 7: No structures are in immediate risk at this time although it is evident that the lake edge has moved back several feet over the past years. The lake bank in this area has a 2 to 3 foot vertical drop at the water's edge. In addition, the slopes of the backyards in this area are very steep. As a result, this area should be both stabilized and restored. The installation of either the Geotextile tube system, the Geoweb cellular confinement system, or the coir rolls system (turtle logs) with a pre-vegetated plant mat is recommended. Additional fill should be added in this area to restore the lake bank to near original conditions. Due to the steepness of the lake bank in this segment, construction access may be difficult.

Segment 8: The edge of the lake in this segment is moderately eroded; the road along this segment is not in immediate risk. Dense planting and a pre-vegetated plant mat or the coir fiber matrix system should be installed to prevent further loss of bank material. The existing headwall structure requires backfill and stabilization to prevent further deterioration.



DATE:	OCT-2003
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CHKD. BY:	D.M.V.
PROJ. #	12478


LAKE CONSTANCE
LAKE BANK RESTORATION & STABILIZATION

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 PINELLAS COUNTY, FLORIDA

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EB No. 2904
 LB No. 2904
 IC No. 371



LAKE CONSTANCE



SEGMENT 1



SEGMENT 2

LAKE CONSTANCE



SEGMENT 3



SEGMENT 4

LAKE CONSTANCE



SEGMENT 5



SEGMENT 6

LAKE CONSTANCE



SEGMENT 7

B. Lake Taranto

Segment 1: The edge of the lake in this segment is moderately eroded; the “land bridge” along this segment is not in immediate risk. Dense planting and a pre-vegetated plant mat or the coir fiber matrix system should be installed to prevent further loss of bank material.

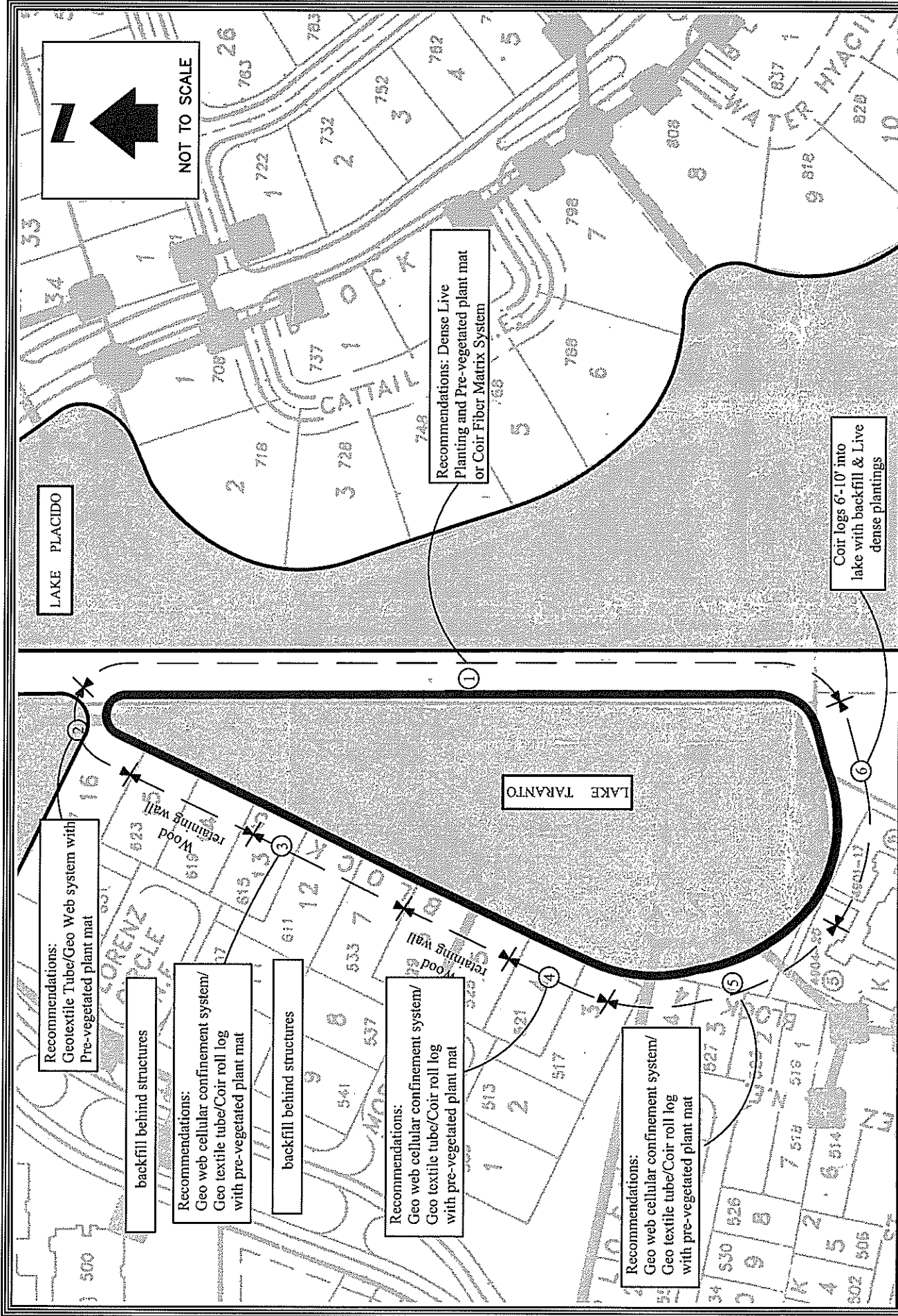
Segment 2: A residential structure is in close proximity to the lake edge along this segment of the lake. The erosion in this area has created a 3 foot vertical drop at the water’s edge. As a result of these conditions, this area needs to be both stabilized and restored. The installation of either the Geotextile tube system or the Geoweb cellular confinement system with a pre-vegetated plant mat is recommended. Additional fill should be added in this area to restore the lake bank to near original conditions. This area has adequate room for construction access.

Segment 3: No structures are in immediate risk at this time although it is evident that the lake edge has moved back several feet over the past years. The lake bank in this area has a 2 to 3 foot vertical drop at the water’s edge. In addition, this area is between two segments of the lake where vertical retaining walls have been constructed. As a result, this area should be both stabilized and restored. The installation of either the Geotextile tube system, the Geoweb cellular confinement system, or the coir rolls system (turtle logs) with a pre-vegetated plant mat is recommended. Additional fill should be added in this area to restore the lake bank to near original conditions. This area has limited room for construction access. It was also noted that the headwall structure in this area appears to be displaced and should be stabilized.

Segment 4: No structures are in immediate risk at this time although it is evident that the lake edge has moved back several feet over the past years. The lake bank in this area has a 4 foot vertical drop at the water’s edge. In addition, this area is adjacent to a segment of the lake where a vertical retaining wall has been constructed. As a result, this area should be both stabilized and restored. The installation of either the Geotextile tube system, the Geoweb cellular confinement system, or the coir rolls system (turtle logs) with a pre-vegetated plant mat is recommended. Additional fill should be added in this area to restore the lake bank to near original conditions. This area has limited room for construction access.

Segment 5: No structures are in immediate risk at this time although it is evident that the lake edge has moved back several feet over the past years. The lake bank in this area has a 3 foot vertical drop at the water's edge. In addition, the slopes of the backyards in this area are very steep. As a result, this area should be both stabilized and restored. The installation of either the Geotextile tube system, the Geoweb cellular confinement system, or the coir rolls system (turtle logs) with a pre-vegetated plant mat is recommended. Additional fill should be added in this area to restore the lake bank to near original conditions. Due to the steepness of the lake bank in this segment, construction access may be difficult.

Segment 6: The edge of the lake in this segment is moderately eroded; no structures in this segment are in immediate risk. Dense planting and a pre-vegetated plant mat, the coir fiber matrix system, or the coir rolls systems (turtle logs) should be installed to prevent further loss of bank material.




DATE:	OCT-2008
SCALE:	AS NOTED
DRAWN BY:	L.C.G.
CHECKED BY:	D.M.V.
PROJ. #	12478
EXHIBIT	

LAKE TARANTO
LAKE BANK RESTORATION & STABILIZATION
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LAKE TARANTO



SEGMENT 1



SEGMENT 2

LAKE TARANTO



SEGMENT 3



SEGMENT 4

LAKE TARANTO



SEGMENT 5



SEGMENT 6

C. Lake Placido

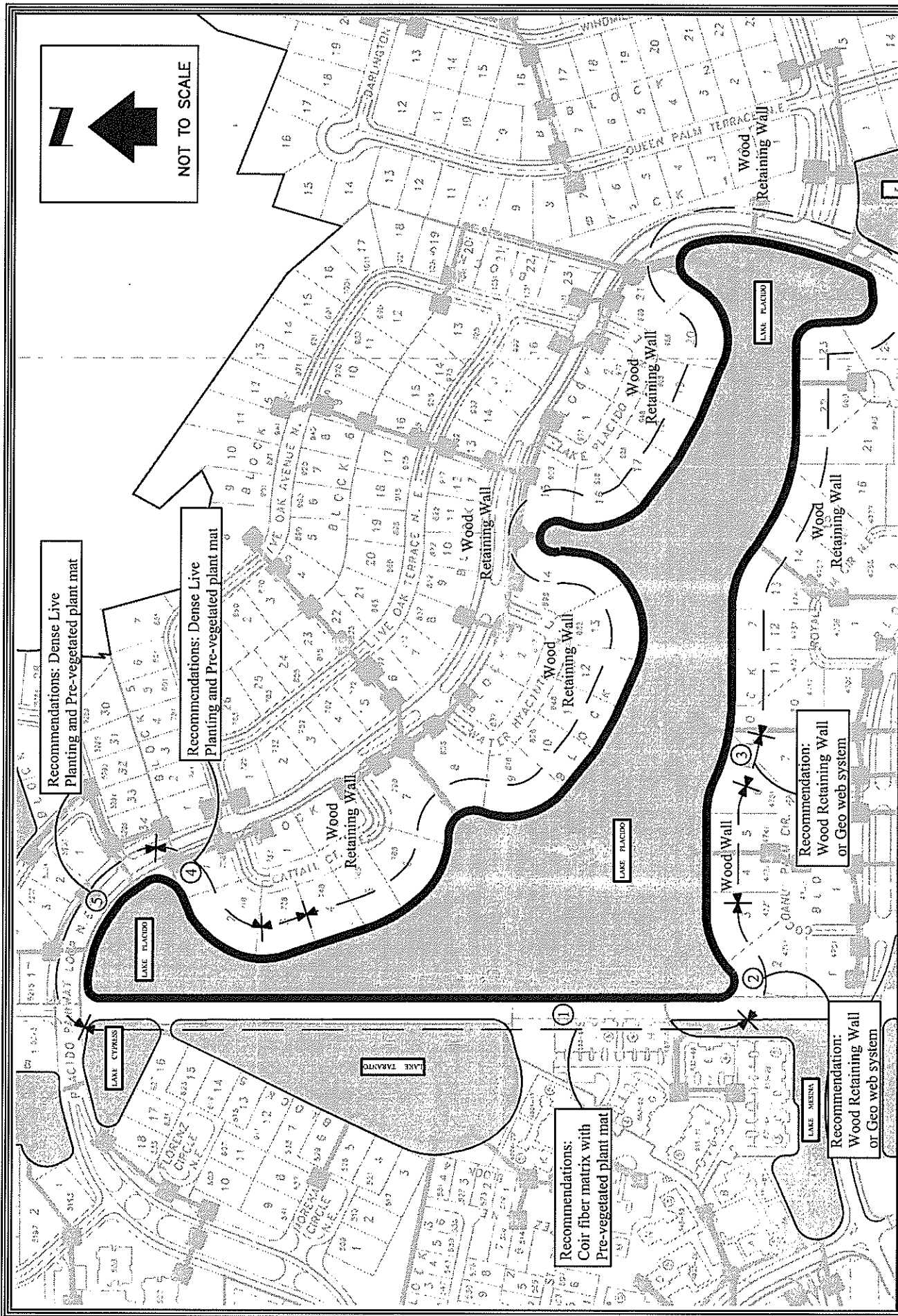
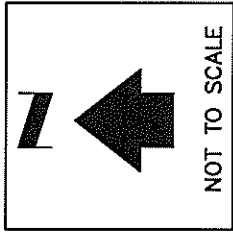
Segment 1: The edge of the lake in this segment is moderately eroded; the “land bridge” along this segment is not in immediate risk. Dense planting and a pre-vegetated plant mat or the coir fiber matrix system should be installed to prevent further loss of bank material.

Segment 2: No structures are in immediate risk at this time although it is evident that the lake edge has moved back approximately 8 feet over the past years. The lake bank in this area has a 2 to 3 foot vertical drop at the water’s edge. In addition, this area is adjacent to a segment of the lake where a vertical retaining wall has been constructed. Due to the proximity of the wall, either a continuation of the wall or the Geoweb cellular confinement system is recommended for this segment. Additional fill should be added in this area to restore the lake bank to near original conditions. This area has limited room for construction access.

Segment 3: No structures are in immediate risk at this time although it is evident that the lake edge has moved back approximately 12 feet over the past years. The lake bank in this area has a 3 foot vertical drop at the water’s edge. In addition, this area is between two segments of the lake where vertical retaining walls have been constructed. Due to the short section of unprotected lake edge, a continuation of the retaining wall is recommended for this segment. Additional fill should be added in this area to restore the lake bank to near original conditions. This area has very limited room for construction access.

Segment 4: The edge of the lake in this segment is moderately eroded; no structures are in immediate risk. The slope of the backyards in this segment is relatively flat. Dense planting installed along the shoreline should be sufficient to prevent further loss of bank material.

Segment 5: The edge of the lake in this segment is moderately eroded; no structures or roads are in immediate risk. The lake bank slope in this segment is relatively flat. Dense planting or the coir fiber matrix system installed along the shoreline should be sufficient to prevent further loss of bank material.



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LAKE PLACIDO
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LAKE PLACIDO



SEGMENT 1



SEGMENT 2

LAKE PLACIDO



SEGMENT 3



SEGMENT 4

LAKE PLACIDO



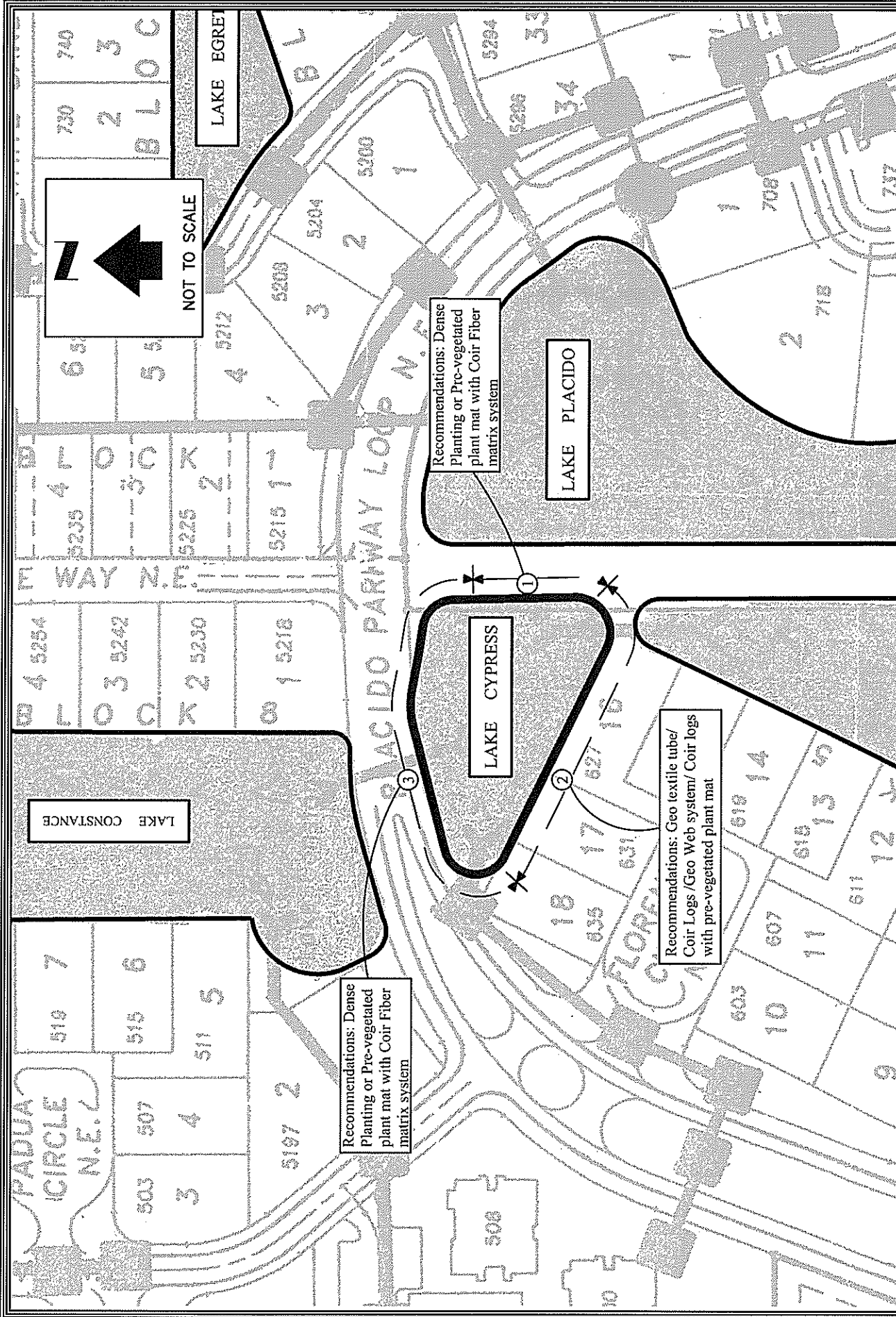
SEGMENT 5

D. Lake Cypress

Segment 1: The edge of the lake in this segment is moderately eroded; the “land bridge” along this segment is not in immediate risk. The lake bank edge has eroded back during the past years. The lake bank in this area has a 2.5 foot vertical drop at the water’s edge. Dense planting and a pre-vegetated plant mat or the coir fiber matrix system should be installed to prevent further loss of bank material.

Segment 2: No structures are in immediate risk at this time although it is evident that the lake edge has moved back several feet over the past years. The lake bank in this area has a 3 foot vertical drop at the water’s edge. In addition, the slopes of the side yard in this area are very steep. As a result, this area should be both stabilized and restored. The installation of either the Geotextile tube system, the Geoweb cellular confinement system, or the coir rolls system (turtle logs) with a pre-vegetated plant mat is recommended. Additional fill should be added in this area to restore the lake bank to near original conditions. Due to the steepness of the lake bank in this segment, construction access may be difficult.

Segment 3: The edge of the lake in this segment is moderately eroded; the road along this segment is not in immediate risk. Dense planting and a pre-vegetated plant mat or the coir fiber matrix system should be installed to prevent further loss of bank material.




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LAKE CYPRESS
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LAKE CYPRESS



SEGMENT 1

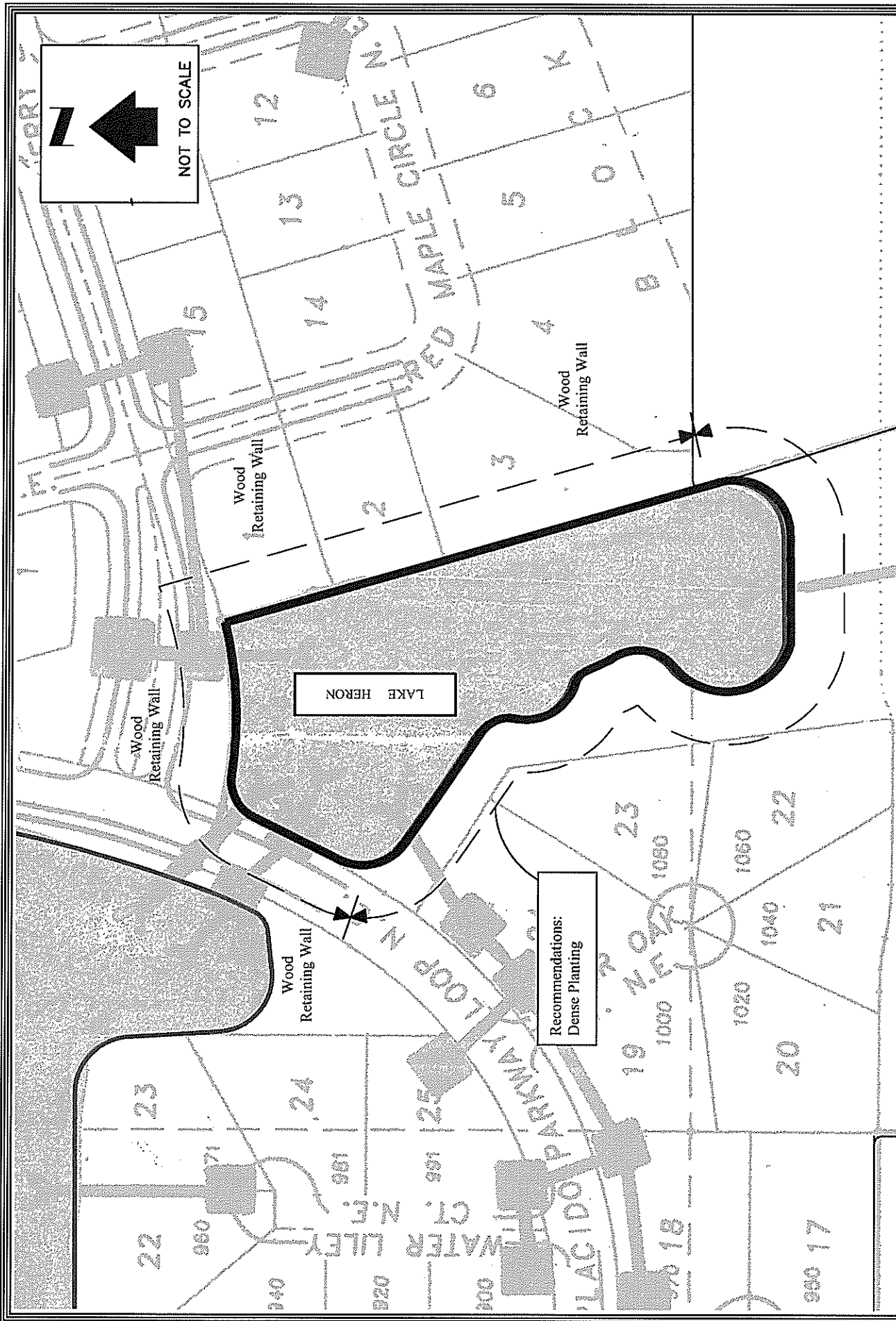


SEGMENT 2

E. Lake Heron

Over fifty percent of this lake has been protected with pressure-treated wood retaining walls. The unprotected side of the lake is only moderately eroded; no structures are in immediate risk. The slopes of the backyards in this segment are relatively flat. Dense planting installed along the shoreline should be sufficient to prevent further loss of bank material.

It should be noted that the outfall pipe from this lake has no control weir that prevents backwater flow from increased tide levels. It was also noted that a bracket for a weir plate (aka: threshold sill) was attached to the outfall pipe. During the field inspection, it was noted that grasses along the shoreline were dead. This was likely due to salt water backflow that resulted from the very high tide conditions created during the passage of Hurricane Ike. A small weir plate, or threshold sill should be installed to prevent future backflow of tidal water into the lake.




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LAKE HERON
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LAKE HERON



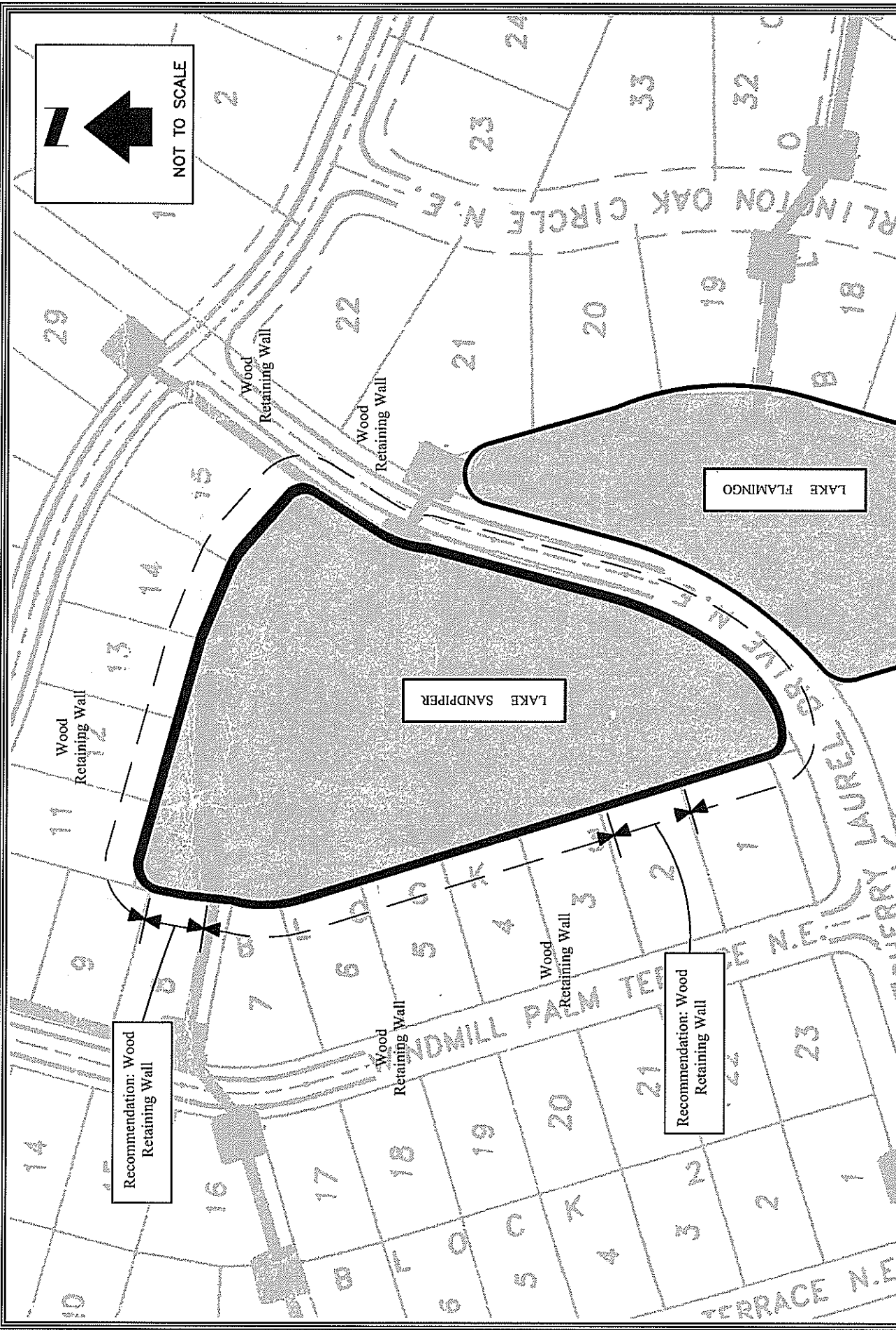
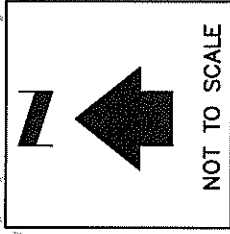
GENERAL VIEW



EXISTING RETAINING WALL

F. Lake Sandpiper

Over ninety percent of this lake is protected by pressure-treated wood retaining walls. Only two lots along the lake have unprotected shorelines. Since these two lots are between segments of the lake where vertical retaining walls have been constructed and due to the short section of unprotected lake edge, a continuation of the retaining wall is recommended for these segments. Additional fill should be added in these areas to restore the lake bank to near original conditions. These areas have very limited room for construction access.




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LAKE SANDPIPER
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LAKE SANDPIPER



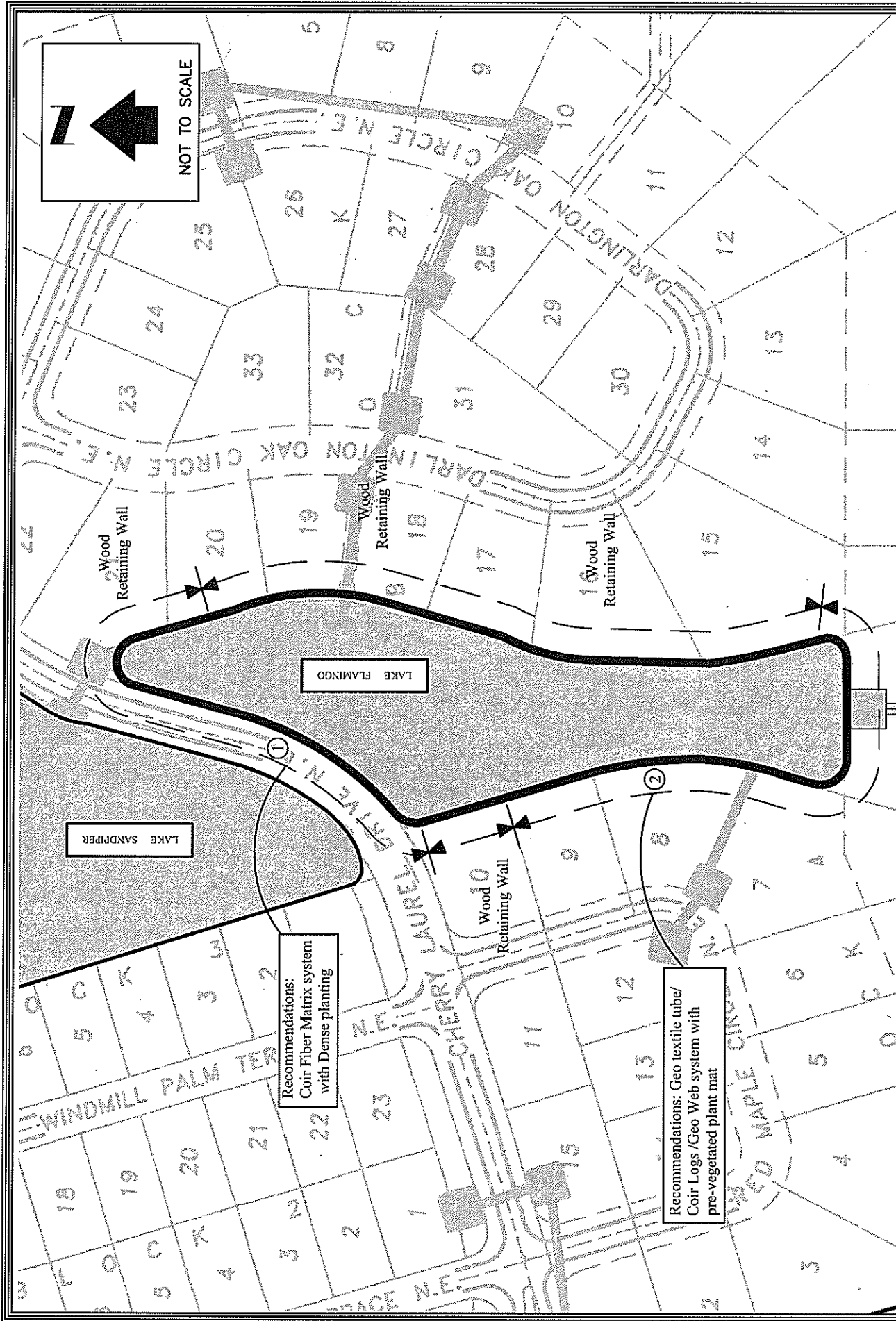
GENERAL VIEW

G. Lake Flamingo

The entire eastern shoreline of this lake is protected with a pressure-treated wood retaining wall. The remainder of the lake's shoreline is unprotected except for a single lot on the northwest corner of the lake (Lot 10).

Segment 1: The edge of the lake in this segment is moderately eroded; the road along this segment is not in immediate risk. Dense planting and a pre-vegetated plant mat or the coir fiber matrix system should be installed to prevent further loss of bank material.

Segment 2: No structures are in immediate risk at this time although it is evident that the lake edge has moved back several feet over the past years. The lake bank in this area has a 3 foot vertical drop at the water's edge. In addition, the slope of the backyards near the water's edge is very steep and show signs of failure. As a result, this area should be both stabilized and restored. The installation of either the Geotextile tube system, the Geoweb cellular confinement system, or the coir rolls system (turtle logs) with a pre-vegetated plant mat is recommended. Additional fill should be added in this area to restore the lake bank to near original conditions. Due to the existing retaining wall at the north end of this segment, construction access may be difficult from the west side of the lake. Access would have to be made from the east side of the lake.



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LAKE FLAMINGO
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LAKE FLAMINGO



SEGMENT 1



SEGMENT 2

LAKE FLAMINGO



STRUCTURE SEGMENT 2

